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**The Street Railway Convention.** THE Milwaukee meeting of the American Street Railway Association was an unusually successful one, not only in attendance, but in the character of papers read and in the discussions on them as well as on other subjects brought before the meeting. The most important paper is probably that of Mr. Mailloux, on auxiliary storage battery plants, to which we refer elsewhere, but those on direct-driven generators and on power house engines treat timely topics in an able and practical manner. In view of the recent preponderance of opinion in favor of belted generators on account of supposed greater immunity from breakdown in case of short-circuits, the positive expression of competent opinion in favor of the direct-connected type for power houses is important and will go far toward definitely settling the question. The conclusions in regard to the use of compound, and especially triple expansion, engines for street railway work are more open to criticism. There is a lack of definite data bearing on the economy of these types when they are subjected to great variations in load, and the question of their use except on the largest street railway systems may still be considered an open one. That part of the report on the heating and lighting of street railway cars that refers to electric heaters will doubtless be questioned, particularly as no weight is given to the saving in seating room and the great cleanliness and convenience that accompany the use of electric heaters. While the omission of the paper on the T-rail is to be regretted, a discussion on the same subject to some extent atoned for it. It is gratifying to note the continued interest taken in these periodical gatherings, which, aside from the papers read, are of great value in accelarating improvement through individual comparison of notes and in exciting personal emulation.

**Patent Law.** IN the recent Western Electric (Scribner) arc lamp decision, two important points of general interest are defined by the United States Court of Appeals, before which the case came. The first relates to the distinction between the abandonment of an invention and the abandonment of an application for letters patent by failure to carry out certain provisions of law. The court held that besides the power conferred upon the Commissioner of Patents to relieve an applicant from an abandonment of his application under the statute, an application which had lapsed or been rejected or withdrawn may be renewed or repeated so long as the invention itself has not been abandoned by reason of a two years' public use, or otherwise. The other point has a collateral bearing on the trolley cases now in court, as it relates to the question if the change in functions of a device constitutes an invention—a question before referred to in these columns. The court holds that the invention is in the device. In the case at issue the judge illustrated the distinction by the statement that the magnetic current itself is not a part of the device any more than water is an element of a water wheel; in one case water is the power and in the other the electric current, and devices are contrived for the purpose of controlling and applying the power. This view is interesting in connection with the claim that the fundamental mechanical principles involved in the street railway trolley were anticipated by numerous patents previously issued for trolleys to be used in the operation of telegraph instruments on steam railway cars, and therefore the trolley patents in litigation are void through resting on a mere functional difference—conveying a small current to a telegraph instrument in one case and a large current to a motor in the other.

**Dynamos and Their Prime Movers.** A FEATURE of some interest regarding the relative sizes of dynamos and the machines which are used to drive them is shown quite nicely in some exhibits at the World's Fair. In all cases where there is direct driving, or where a single engine drives a single dynamo, it may be assumed that the dynamo and its prime mover are practically of the same horse power; when the prime mover is a steam engine it will be noticed that the difference between the sizes, floor space, etc., of the dynamo and the engine is very greatly in favor of the former, the proportions being, perhaps, roughly, about as one to three, or at least as one to two; if the boiler is included with the steam engine, as it should be, the difference becomes very much greater. This shows that, besides being a much more efficient transformer of energy, the dynamo has a very much greater output per pound, per volume or per square foot of the floor space, than the steam engine, especially when the boiler is included. The lower the speed the greater this difference seems to be, or, in other words, the engine seems to decrease less in size at higher speeds than the dynamo. But we noticed that the case was different in the high speed water wheel that drives the dynamos in the General Electric Company's exhibit; here the dynamo and the water wheel appeared to be very nearly the same size. On making a comparison in the case of the high speed steam turbine, exhibited in the Swedish Department in the Machinery Building, we noticed that the tables were completely turned and that here the relative sizes were just about the reverse of what they are in the case of the usual steam engine. Here a small eight-inch wheel running at a speed of 20,000 revolutions per minute developed 20 h. p., if the statements made to us were correct, and we have no reason to believe that they were not. It is needless to say that the dynamo which it was driving was far greater in size, even the gearing for reducing the speed down to one-half occupying a much greater volume than the engine itself; if, however, the boiler is included the difference is again in favor of the dynamo.

**Storage Batteries for Street Railways.** IN another column we print an abstract of Mr. C. O. Mailloux's elaborate report to the American Street Railway Association on storage batteries as auxiliaries in central lighting stations and power houses, which is one of the most valuable contributions to the subject yet made. In the report it is clearly shown that in some cases a power plant may be built and operated at less cost through the use of storage batteries, and a more uniform potential maintained at the station or on the line. A calculation based upon commercial data gives additional weight to the conclusions arrived at, which, we feel assured, will not lack due consideration with the shrewd and progressive men engaged in street railway enterprises. As will be seen, the principal function of a storage battery in street railway service would be to work the generating plant at its full capacity, thus securing greater economy in the operation of both the engines and dynamos, and largely reducing the size of the plant. It is also pointed out that by the use of storage batteries in substations all the machinery of the street railway system covering a large territory may be concentrated at one place and a large saving of copper made besides by arranging the batteries to be charged at a potential higher than that of the trolley circuit. It has always been a matter of surprise that European practice in regard to the use of storage batteries in central lighting stations has not been heeded in this country; had we more experience in this line it is probable that the question of their practicability for use in power stations would now be definitely settled one way or the other instead of just being broached. One reason for this neglect has been the large day load carried by many American stations, thus keeping up the average load, and the report shows that the same consideration affects their use for street railway purpose, the recommendation extending to plants supplying less than 200 cars or, in other words, where there is a considerable fluctuation or variation in the demands for power. It should be borne in mind that the storage battery which would be used in the work referred to is entirely different from the many types made in this country, and as the necessity of small weight does not exist, the plates are not subject to the rapid deterioration which has resulted in so many failures of storage battery traction schemes.

**Still Furnishing the "Details."** THIS week's report of Mr. Martin's case commences with the testimony given in behalf of the defendants. While by reason of the very peculiar features in some respects of Mr. Martin's case, and the exclusive sources in which knowledge of the details of his actions were sometimes confined, we may not always have been able to clear up, as satisfactorily as we desired, some little incidents disclosed here and there by his testimony, yet by what is contained in this week's story we furnished numerous contradictions of Mr. Martin, and we also supplied the details of many things which both he and the treasurer of the *Electrical Engineer* appear at the time referred to to have entirely forgotten. And in some instances where it has not been in our power to do as much as this, by word of mouth testimony, we have managed with considerable success to bring the details which Mr. Martin gave into sharp contrast with incidental facts and circumstances, which are always of great aid in getting at the truth of any perplexing problem, and which in the present instance make the contrast between the two sides an interesting and somewhat instructive one. When at this day we placidly and serenely scan, as only the victor who has made an honest fight and won can do, all the follies and frailties which the ventilation needed to calm or quiet Mr. Martin's tempest in a teapot laid bare, we are amused at the spectacle which comes before our mind—pride humbled: confidence wiped out: and plans which were maturely and deliberately formed laid to sleep as silent monuments or reminders of hopes which, alas! have not been realized. To think that for nearly three years men of a higher order of education should have been engaged in such a strife, wasting therein their money, brains and energies, taking away all these from their regular and, we suppose, more profitable pursuits, and at the end of it all accomplish—what? Merely the exposure of doings and sayings which they never meant, wished or intended should be exposed; and the exposure of which, to-day, to them, must necessarily be a matter of regret. It is amusing when we think how that siren Hope, aided by someone's weakness or simplicity, brought about all this, and with it defeat and the mortification which always follows defeat. Yet Mr. Martin and all who, both individually and journalistically, so cheerfully joined him in his wild attack on THE ELECTRICAL WORLD risked all this in the hope of attaining their ends. It is not pleasant to know that in doing that they were doing nothing more than men are oftentimes impelled to do in this community. And about the oddest part of all this is that all such so called legal contests are carried on strictly in accordance with what is known as *law*, and the time and attention of courts organized and maintained to administer what is called *justice* are engaged every day in the week hearing just such controversies and determining just such *rights* as those claimed on behalf of Mr. Martin in this case. We have no disrespect for the law, and we certainly have no reason to find fault with the courts. We think shams rarely if ever get out of them with any semblance of life, when they are properly met and challenged therein, but we do regret that sometimes from necessity and sometimes by the aid of perverted ingenuity it should take so long to expose that which should always for the moral health of the community be exposed promptly—a sham.

## The Monthly Meeting of the American Institute of Electrical Engineers.

The 80th meeting of the American Institute of Electrical Engineers, at which there was a large attendance, was held at its headquarters in New York on Oct. 18, with President Houston in the chair. The discussion of the previous meeting on the action of the council in ordering to be printed in the Transactions without reading a paper by a non-member of the Institute which had been read before another society, was resumed through a member asking for information in regard to what disposition had been made of the protest then entered. The chair stated that the matter had been finally disposed of at the last meeting. A request for a reading of that part of the minutes relating to Dr. Morton's paper was opposed by Mr. G. M. Phelps, but some time later the reading was directed, after a vigorous protest by Mr. G. H. Hamilton against this right being denied to a member.

During the discussion Mr. Phelps claimed that the Institute had no right to review the action of the council, in which view he was supported by one or two other members, but opposed by the chair, who stated that the creature could not be higher than the creator; after a desultory discussion of this and other questions relating to Dr. Morton's paper, Mr. Phelps stated that in this instance, in order to dispose of the matter definitely, he was willing that a vote should be taken by the Institute in regard to the action of the council on the paper criticised, although he denied the actual right of the Institute to such a vote. After the entire discussion had lasted almost or quite an hour a vote was finally taken, which was 35 to 14 in favor of sustaining the council.

Dr. F. Bedell read a paper, prepared by himself, Mr. K. B. Miller and G. F. Wagner, on the hedgehog transformer with and without a condenser in parallel, in which a new method of instantaneous contact is described, and some of the results of tests made by means of it on the hedgehog transformer are detailed. Although the subject is one that is rather difficult of treatment in simple terms, yet the authors succeeded in producing a paper not only free of mathematics, but one which can even be followed with little previous acquaintance with the theory of transformers or alternating currents, thus following the admirable precedents established by Mr. Kennelly and Dr. Pupin. The discussion on the paper was confined to Dr. Pupin and Mr. Kennelly, who referred in a brief manner to several points in the paper.

Mr. R. W. Pope, the secretary of the Institute, then read a paper on the "Monthly Meetings of the Institute. Their Origin and Proposed Development." That part of the early history of the Institute bearing on the question is given at length with quotations from the records, and the practice of other engineering societies in regard to local sections is referred to. The paper outlines a plan by means of which local meetings may be held in other places than in New York with no change in the rules—a plan that will doubtless receive the consideration it deserves from the author's wide acquaintance with the subject, and his indefatigable devotion to the interests of the Institute. The reading of the paper was finished at such a late hour that there was little discussion. Dr. Emery submitted a paper as part of the discussion elaborating a plan for the establishment of local meetings, and Mr. H. L. Webb, after some remarks, submitted a resolution requesting the president to appoint a committee from among members of the council to consider the entire question of local meetings, which was seconded by Mr. G. M. Phelps and adopted, and a committee was named consisting of Messrs. Webb, Phelps, Pupin and Kennelly. The omission of the two gentlemen who read papers on the subject was doubtless an oversight due to haste in naming the committee as the meeting was breaking up.

It is learned that the council deferred action on the request from Chicago, made under a provision in Rule VI., to hold a local meeting there.

The following applications were made to the council for associate membership: Merton H. Bentley, Oak Park, Ill.; Richard Fleming, Rockford, Ill.; J. A. McCrossan, Rat Portage, Ont.; Loyall A. Osborne, Newark, N. J.; Russell Robb, Boston, Mass., and Henry H. Sykes, Brooklyn, N. Y.

## Lightning Discloses a Mineral Spring.

During the prevalence recently of a thunderstorm in the neighborhood of Seis, in the Tyrol, the lightning struck a heap of old wood which was piled on a rock, splitting the latter and setting fire to the former. When the flames had been extinguished it was noticed that a stream of water flowed from amidst the rubbish. Further examination showed that the stream proceeded from the lightning-created cleft in the rock, and chemical analysis demonstrated that the water was impregnated with iron and magnesium, in the form of sulphates.

## Electrical World Portraits.—No. XXXVII.

PROFESSOR ERIC GERARD.

Eric Gerard was born in Liege, Belgium, on Sept. 22, 1856. He followed the course at the University of Liege, which in 1878 granted him a diploma as engineer of arts and manufactures, and after completing the course at the Superior School of Telegraphy, he was named a telegraphic engineer. In 1883 M. Montefiore-Levi, a member of the Belgian Senate, founded an electrical technical institute at Liege, and M. Gerard was called to undertake its direction. Great difficulties accompanied this honorable charge, and to some the task would have been too heavy, but the young professor did not lose courage, and a complete success has been his recompense. That the position was one of difficulty will be apparent from the fact that the new institute was specially destined for the instruction of graduated engineers, and the professor thus found himself in many cases younger than his pupils. Notwithstanding this, Prof. Gerard inspired in his scholars a sentiment of profound respect, and the many who left his school cherish in an unusual degree feelings of affection for the young professor. He followed personally the experiments of his pupils, and was thus always able to furnish to those who desired to learn the clear and precise information suitable to their needs.

Perhaps the greatest difficulty was presented in the formation and carrying into effect of the vast programme which the aims of this institution and its young professor involved. There was an entire lack of precedents, for Prof. Gerard's idea was not the

PROFESSOR ERIC GERARD.

education of specialists, but the formation of engineers who should be taught all that was newest and best in the theory and practice of each branch of electrical application. The rapid advances in electrical science and its applications—then just commencing to develop—had left in the rear the ordinary means of guidance, and the teaching programme had no assistance from text books. It was here that Prof. Gerard demonstrated that those who had called him to this important charge had made an excellent choice. He arranged a complete programme, and on that programme arranged lessons no less complete, which have been united in a book that has had a remarkably extensive circulation. This work, published in two volumes, has in two years passed through no less than three editions and been translated into German. Written in exact and clear language, it is a model of its kind; no disproportion exists, each part being treated with equal care and the very newest ideas and their consequences brought within easy reach of the student.

The good effects of the generosity of Mr. Montefiore-Levi and of the work of Prof. Gerard did not fail to appear, and students from every part of Europe flocked to attend the course. In the last several years 200 pupils have followed the course of the Institute, and of this number only half were Belgians. In view of the remarkable results achieved the Belgian government put at the disposal of the Institute a magnificent building, of which a description appeared in The Eelectrical World of Aug. 5, 1893. If the plans are examined with attention it will be found that the most minute details have been studied to the end that the Institute shall have all of the facilities that can be provided for the teaching of electricity.

During these years of teaching, Prof. Gerard has paid particular attention to the perfecting of electrical measuring instruments. In 1886 he modified the Edelmann quadrant electrometer by making it aperiodic, and added to the polar pieces differential galvanometer attachments permitting the field of the bobbin to be modified. In 1886 Prof. Gerard published in "La Lumiere Electrique" a description of an ingenious method for registering rapid movements such as the oscillations of deflecting galvanometers. Besides these, other innovations and important transformations in the method of electrical measurement are described in his lessons.

Several important electrical firms have made propositions to Prof. Gerard with a view of availing themselves of his services in their business, but he has always refused in order to continue his work in the Institute. The affection and gratitude of his present pupils, as well as of the graduated ones, in all of whom he still continues his interest, have certainly contributed to the resolution of Prof. Gerard to never leave the Institute which by his work has given such brilliant results, and in this decision those also ought to be grateful who are interested in the real progress of electricity. Prof. Gerard is a Chevalier of the Legion of Honor, the Iron Crown and of several other orders.

## Laboratory Notes.—VII.

BY LIEUT. F. JARVIS PATTEN.

This system of winding and connections for a ring armature has been considered worthy of a somewhat detailed description because, unlike other cross-connected windings, there is never any complete rupture or opening of the armature circuit, a great point to be gained, while at the same time the short circuit previously referred to that occurs in other forms on the bridging of segments oppositely connected is avoided; the sparking will, therefore, not be objectionable with high voltages and heavy currents, and such a winding can be safely made for large power if required. This winding is, therefore, suitable for the armature of a motor to be operated by alternating currents on commercial circuits, in case it is desired to use power from such a circuit as a source of energy in the workshop. Such a machine will be self-starting, and, as will be seen, it may be given any desired speed within limits for its synchronous speed, or that at which it will continue revolving in unison with the dynamo at the source of supply.

To arrange such a machine as an alternating current motor it is only necessary to provide it with another commutator from which to draw a direct current field circuit. Literally speaking, it is a pulsating direct current, which, however, will answer most purposes. The plan for this arrangement is shown in Fig. 9. With 32 segments in the main commutator, as supposed in the previous description, there will be eight reversals of current to a revolution.

The commutator for supplying the field need, therefore, have but eight segments, which will be connected alternately direct and reverse to the eight equidistant segments, 3, 7, 11, 15, etc., of the main commutator, through which a maximum positive or negative current is sent. The cross connections rectify the negative impulses for the field circuit when the armature is moving in synchronism.

The machine is supplied with alternating curent at the brushes, $b_1$ $b_2$ supplying the armature, and the field circuit is taken from the brushes, $b_3$ $b_4$, bearing on the eight-part commutator in shunt relation to the armature. The machine is self-starting, because, while at rest, the poles of the armature and field are simultaneously changing, thus causing a continuous rotary effort in one direction, and this continues until synchronism is reached, when the current being rectified in both the armature and field, their polarities will remain fixed and the machine will be operated by a rectified alternating current, which, however, it will be noticed, is not actually broken up into positive and negative fragments as when an ordinary rectifying commutator is employed for this purpose, as in the

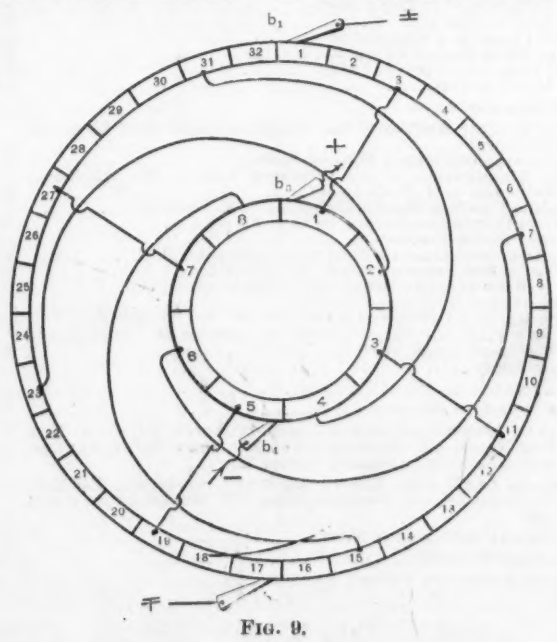


FIG. 9.

Zipernowsky alternating motor, which carries an ordinary rectifier to rectify sufficient current for the field, the starting principle being different.*

A convenient number of reversals per revolution for operating a machine of this type on a commercial circuit is 16, giving a speed of 1,000 at 16,000 reversals a minute—an average American frequency.

*See Kapp's book on "Alternating Currents," pp. 138 and 139.

Such a ring armature can be easily got up by using a form that I have found a great all-round convenience for laboratory work and will be found excellently adapted to the construction of many of the devices described in these papers.

It is a toothed Gramme ring, built up of laminated iron and made in about the same form by both the Elektron Company and the Riker Electric Company. It is provided with 96 slots for winding as many armature coils, which are embedded in the iron when properly wound, both on the inside and outside surfaces, so that the iron presents a true cylindrical surface on the inside of the ring as well as on the outside. This very important feature admits of using an interior revolving field if desired, and is excellently adapted to making rotary field machines, transformers and the like. The machines indicated by diagrams of parts in the first two papers of this series were made of such rings, one having an interior revolving field of the closed circuit type and the other a fixed external field of the ordinary form. If, therefore, it is desired to use such a ring for making an armature like that just described to go at 16 reversals per revolution, the 96 coils will first be connected up in two continuous windings all around the ring, making 48 coils in each winding, which will then be separated into 16 groups of three coils each, and there will be 48 + 16 = 64 segments in the ring collector, which will be divided into 16 groups of four segments each; these will be then connected to the two windings, as shown in Fig. 7, there being in all 64 segments instead of 32, as there indicated. Every fourth segment of this collector, beginning with segment No. 3, will then be connected alternately direct and reverse to successive segments of a 16-part collector on the plan indicated in Fig. 9, and the field circuit of the machine will be connected to a pair of brushes bearing on this auxiliary collector. Such a form of machine will be found a very useful adjunct to the laboratory as a synchronizer for driving other devices, and constructed from the ring described, having 96 coils, it can be altered to run in synchronism at quite a wide range of different speeds. Thus, with a 16-group system of connections, it keeps pace with a 16-pole alternator, running at 1,000 revolutions per minute, but with 32 groups it could be made to go half as fast, and with 8 groups it would run at twice the pace on the same frequency of the alternating current. It is thus extremely well adapted to working with commercial frequencies, while such machines as those indicated in the first two papers are simpler and far superior in many respects for working with low frequencies or with such frequencies for instance as would be derived from the motor dynamo for the laboratory that was first described.

Before leaving the general subject of the motor dynamo and laboratory circuits it will be well to describe an exceedingly convenient and useful form of such a machine that I have recently put into shape with but little outlay and little change in the commercial form of the well known Brush incandescent machine of the smallest size. This machine, the circuits of which are shown by diagram in Fig. 10, will be found to have

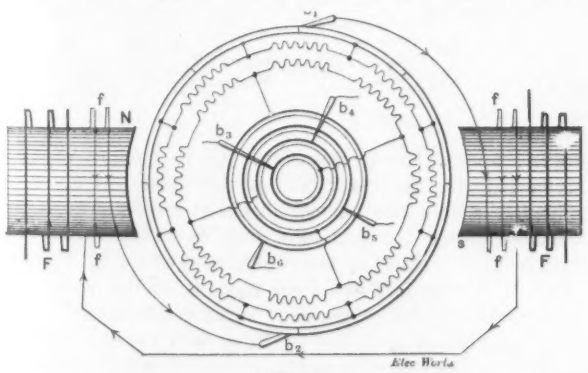


FIG. 10.

a double armature winding of No. 5 wire. As provided for the trade, these two windings are simply connected as a double circuit of two wires. There are eight such coils of two wires wound on the iron ring core. The ends of these coils are first separated, then each winding is connected up in a single series by itself, as shown in the figure. One of these armature windings, which I will call the motor winding, is then connected to an eight-part commutator in the ordinary way, thus making a Gramme ring in a two-pole field. The other armature circuit has four equidistant points connected to four plain sliding ring contacts. This is the dynamo winding which will deliver either a single alternating current from the brushes $b_3$ $b_4$ when driven as a motor by a direct current, or it will deliver two alternating currents in quadrature from the four brushes $b_3$, $b_4$, $b_5$, $b_6$ (biphase currents) when so driven. It is, therefore, a motor generator of very easy construction, as will be seen later, for giving either single or biphase alternating currents; or conversely, when driven by biphase alternating currents it will deliver a direct current from the other armature circuit through the brushes $b_1$ $b_2$. In the latter case this current need not be taken through the field, nor need the field be excited in any way. It will be found sufficient to start the machine with biphase currents to simply close one of the field circuits on itself.

*(To be continued.)*

## The Maintenance of the Overhead Line in Electric Street Railways.—II.

BY J. B. CAHOON.

INTIMATELY connected with the subject of overhead lines is that of the maintenance of the track in good condition so that it may perform its share of the work in a satisfactory manner.

In my part of the country (Massachusetts) I have occasion to ride considerably on the electric cars, which form a perfect network through this part of the State, and I find the old tram rail is still in use quite extensively, much to the discomfort of the passengers who patronize the line, and much to the disgust of the cars, were they permitted to say anything. The joints can be felt very, very distinctly, and the cars go bobbing along like a small boat in a heavy chop sea; in fact, I had an example only yesterday, where a friend of mine took a three-hours ride in one of these cars and came back actually sea sick, with all the signs and feelings of a person on a boat.

We all realize that the wear, tear and strain on the cars incident to travel over such a line are something enormous, and it cannot be very long before there will be necessity for the renewal of the car equipment. This question, however, of what rail we shall use, how we shall lay it, how we shall bond it, has been discussed so much that it hardly seems worth while to mention it here at all. Every one knows, or should know by this time, that a deep girder rail weighing at least 60 pounds to the yard, and from that to 90 pounds, depending on the traffic over it, is the only thing fit to use in cities, and a T rail of not less than 45 pounds to the yard for the country roads; and further, that it is nothing short of sheer folly to continue to use the flat tram rail on roads equipped with electric cars.

We have had numerous discussions also on the subject of bonding the rails, but not until 1892, when Messrs. R. L. Warner and Franklin Sheble brought out the question of determining the drop in the rail return by the telephonic and supplemental wire methods, was the matter placed in a light so that it could be practically and intelligently discussed. Mr. Warner very clearly showed in his paper how to determine the resistance of the rail return, and also showed the differences between using no bond, merely a fish plate connecting the rails, using one bond wire of No. 3 copper, and using a bond wire and supplemental return. He also showed very conclusively that it was cheaper to double bond the rails without using a supplemental wire than to do any other way.

Mr. Sheble mentioned in his article a method of bonding by using a flexible iron cable, some ¾-inch in diameter. The flexible part is good because there is always more or less motion at the joints, but it seems to me from all the information I can gather on the subject from actual working tests that the best method to use, taking all things into consideration, is that of double bonding the rail joints with from No. 3 to No. 0000 copper wire, depending on the traffic over the road, but instead of placing the ends of the bonds at a point near the end of the rail, as is the present custom, I should strongly recommend when channel pins are used going back at least 2½ feet from the end of the rail, and placing one bond there and another at, say, three feet from the end of the rail. This will put the joint between the copper and the iron back at such a distance from the joint of the rails that whatever motion takes place at the joint of the rails will not be felt at the point where the bond is placed, and therefore there will not be a gradual working and wearing away of the copper incident to the cars passing over the joint. Bonding in this way is more expensive at the outset, but will last materially longer and give far less trouble than any other methods in use at the present time, with the possible exception of McTighe's method of using a short bond having shoulders upset in it near the ends, and riveting these ends directly into the rail. This method gives a less resistance, but it is somewhat doubtful whether the use of the short bond, being placed as it is so close to the joint, will not suffer excessive wear from the motion of the joint after the latter gets to working, and within a comparatively short space of time break away from the rail. Of course, bonds should be cross connected to those of the opposite rail, and double tracks cross connected at frequent intervals, say, not to exceed 500 feet. This, taken in connection with the sinking of earth plates at intervals of 1,000 feet or so, and connecting these plates, which may be old car wheels, with the rails by several large wires, gives a ground return whose resistance will be a minimum, and whose tendency will be to confine the return current to itself, avoiding the tendency, so frequently found, for the current to jump to gas and water pipes and give trouble therefrom, owing to the electrolytic action set up.

It should be noted in connection with the sinking of earth plates that they are of practically no use at all unless they are put down in moist earth, or, preferably, actual wet places, and must be sunk to a depth of at least two feet below the frost line.

I might also add that unless the connection between the station and rail is of ample carrying capacity, there is liable to be great loss at this point without realizing it. I should recommend that the carrying capacity of the generator connection to the rails be at least that necessary to carry the maximum current that would ordinarily be sent over the line without causing any appreciable rise in temperature. As an example of this, let us suppose the maximum current sent over the line to be 1,000 amperes. To carry this without causing any appreciable rise in temperature, say 27 degrees F. above the air, requires a cross sectional area of 1.57 square inches of copper, which is nearly equivalent to nineteen No. 0 wires.

It will be noted that this is entirely independent of the earth connection, and justly so, because it may happen that through frost or other incidents the ground from generator may be of little or no use, and the whole return current must be carried by the connection to rail.

In this connection I wish to record myself most emphatically as of the opinion that the maintenance of way, the selection of rails and material for the construction and maintenance of the track, should be in the hands of the electrical engineer entirely.

The board of directors and the management in general should not hamper the engineer in any way in his choice. They may rest assured that, inasmuch as the reputation of the engineer is most dear to him, he will if left to himself do that which he knows to be right, and which will bring about the best results, not only to the company, but to himself in the enhancement of his reputation. To the roads who are so unfortunate as not to be possessed of an electric engineer, I will merely say that the sooner they get one the sooner will their road stop going to pieces, and the quicker will they get on a proper dividend paying basis.

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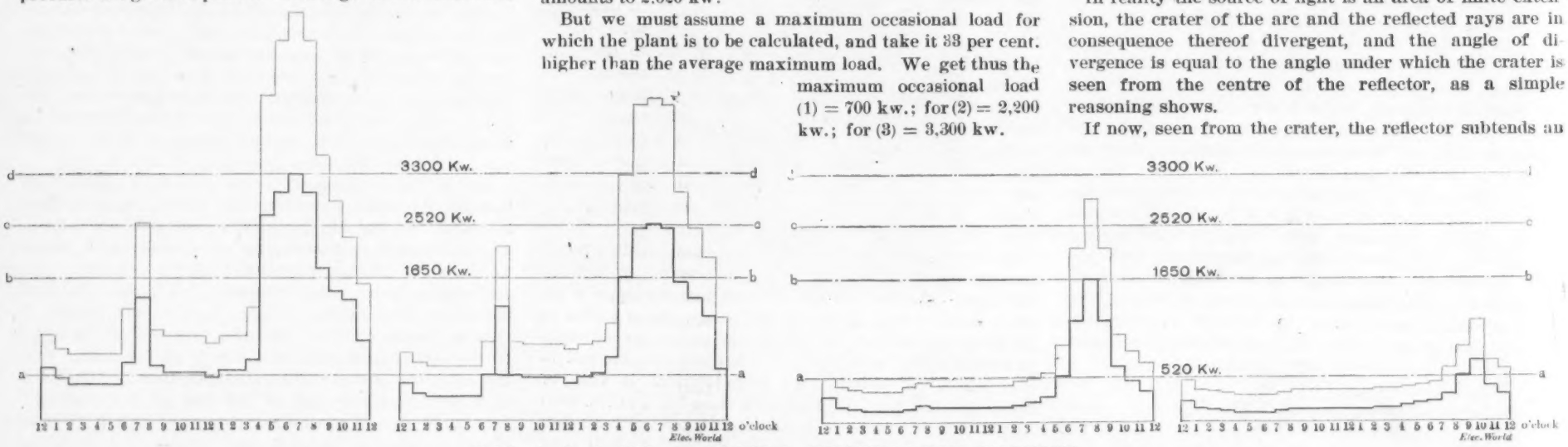
## A New Method of Charging for Electric Supply from Central Stations.

BY OTTO FRICK.

The best tariff for the electric supply from central stations is undoubtedly that which results in the payment of the highest possible interest on the invested capital, and procures the greatest possible advantages to the consumers.




FIGS. 1, 2, 3 AND 4.—CENTRAL STATION LOAD DIAGRAMS.

The price is from financial reasons on the one side limited by the cost of production, on the other by the value the supply has to the customer. If we approach too near to the former limit, the interest on the invested capital will be too small, while the customers derive the greatest possible advantages. If the price be fixed near the latter limit, the profits gained will be the highest possible, without injuring the interests of the customers. Consequently, the best tariff is that which makes the charge for the supply correspond most nearly to its value to the customers.

Unfortunately "the value of the supply" is rather a vague thing. It is not only different to different consumers, but also at different seasons of the year and hours of the day. It is evident that in the dark hours of winter afternoons the value of the light is higher than at noon time in summer.

In order not to complicate matters the difference between different consumers may be neglected, and we may assume a tariff uniform to all, but varying according to season and hours of day. The value of a product increases as the demand for it grows; so it is with the value of the electric energy. Now the cost of generation in the hours of great demand is higher than in the time of small load, and for fixing the rates of charge at different times it may be well to know the costs of production at these different times.

In the following an attempt will be made to investigate this question, applying it to a particular case. An example may be taken of a central station on the alternating current system, for an output of 3,300 kw. at the consumers premises, as designed for the the town of Frankfort-on-Main.

The diagrams, Figs. 1, 2, 3 and 4, which are taken from the publication of this scheme, as worked out in the office of Mr. O. von Miller, show the assumed variation of load on four different days. The heavy line represents the consumption at the lamps during the different hours in one day; the upper line represents the number of indicated horse-power needed to cover the demand. Thus the space between the two zigzag lines represents the losses in cables, transformers, dynamos and engines. Fig. 1 gives the load on a day of greatest demand; Fig. 2 gives the load on a day of average demand in November, December and January; Fig. 3 gives the load on a day of average demand in February, March, April, August, September and October; Fig. 4 gives the load on a day of greatest demand in May, June and July. If the maximum load never rose over that in summer between nine and ten o'clock in the evening, machinery and cables would only have to be provided for this output, say 700 kilowatts, and it is unjust that the rate charged for lamps burning in hours of light load should be higher than if the plant was only designed for them. Likewise is it unjust that customers using the current during day or night in winter have to pay the same rate as those who are using it during the hours between three and ten o'clock in the evening in the summer.

To have the tariff always proportional to the cost of production it would be necessary to make the charge vary with the total load of the station. As this is not possible we may yet arrive at an approximation by establishing three or four different rates of charges. The electricity meters must accordingly be constructed to register at different rates during different times.

In the case for which the above diagrams are plotted we may assume three different rates:

(1) For the hours between midnight and eight o'clock in the evening during May, June and July; between midnight and six o'clock in the evening during February, March, April, August, September and October, and between midnight and 6 a. m. and from 8 a. m. to 3 p. m. during January, November and December.

(2) For the hours between 8 p. m. and midnight in May, June, July; between 6 p. m. and midnight during February, March, April, August, September and October, and from 6 to 8 a. m. and 10 to 12 p. m. during January, November and December.

(3) For the hours between 3 p. m. and 10 p. m. during January, November and December.

The average maximum load during these three periods occurs for (1) between 5 p. m. and 6 p. m. in spring and autumn, and amounts to 520 kw.; for (2) between 7 p. m. and 8 p. m. in spring and autumn, and amounts to 1,650 kw.; for (3) between 6 p. m. and 7 p. m. in winter, and amounts to 2,520 kw.

But we must assume a maximum occasional load for which the plant is to be calculated, and take it 33 per cent. higher than the average maximum load. We get thus the maximum occasional load (1) = 700 kw.; for (2) = 2,200 kw.; for (3) = 3,300 kw.

Now, the rates for the three different periods are to be selected in such a way that, for instance, a lamp burning during (1) has to pay the same as in a plant with a maximum output of 700 kw. and the same annual consumption as in the given instance falls below the line *a*, whose height above the base line corresponds to the average maximum load for (1). Likewise a lamp that burns during (2) has to be charged for at the same rate as in a plant of a maximum capacity of 2,200 kw. and same annual consumption as beneath line *b*, *b*, which gives the height of the average maximum load during (2). The same for the third period.

To fix the costs of production in plants of these different outputs and different load factors we may divide the expenses under the following heads:

I. Interest on capital, depreciation and repairs. II. Management and attendance. III. Coal. IV. Oil. V. Miscellaneous.

In the given instance the annual costs were calculated:

I. $160,000. II. $32,500. III. $43,000. IV. $4,500. V. $24,000. Total, $264,000.

Now we have to fix the amount the annual expenses would reach in plants for 700 kw. and 2,200 kw. output respectively and an annual production as above stated.

I. The expenses for interest and depreciation are greater per kilowatt output the smaller the total output of the plant. For a plant of 3,300 kw. capacity they are $160,000 ÷ 3,300 = $48.50 per kw. For a plant of 2,200 kw. we can assume these expenses to be $53.50 per kw. For a plant of 700 kw. these expenses amount to $70 per kw. Thus, the annual expenses for interest and depreciation for a 3,300-kw. plant = 3,300 × 4.86 = $160,000; for a 2,200 kw. plant = 2,200 × 53.5 = $117,500, for a 700-kw. plant = 700 × 70 = $49,000.

II. Management and attendance will not be very different for different sizes of plant, say: For a 3,300-kw. plant = $32,500; for a 2,200-kw. plant = $26,000; for a 700-kw. plant = $18,000.

III. The expenses for coal can be taken directly out of the diagrams, assuming the coal consumption proportional to the indicated horse power necessary to furnish the current. The diagrams give for (1) 4,075,000 horse-power hours, for (2) 3,415,000 horse-power hours, and for (3) 2,620,000 horse power hours; total, 10,110,000 horse-power hours.

The cost of coal for 10,110,000 horse power hours is given above as $43,000, and thus the expense during

$$(1) \text{ is } \frac{4,075,000}{10,110,000} \times 43,000 = \$17,300$$

$$(2) \text{ is } \frac{3,415,000}{10,110,000} \times 43,000 = \$14,500$$

$$(3) \text{ is } \frac{2,620,000}{10,110,000} \times 43,000 = \$11,000$$

Total, $43,000

IV. The expenses for oil can also be taken from the diagrams, and are found to be for (1) $1,800; (2) $1,600; (3) $1,100; total, $4,500.

For miscellaneous expenses 10 per cent. over all may be added.

*(To be continued.)*

## Candle Power of Search Lights.

BY CHARLES P. STEINMETZ.

In last week's Digest of Electrical Literature I read a statement on the candle power of search lights which seems to me to be misleading. The mistake made is in the assumption that the beam of light of a search light consists of parallel rays. If this were the case, it would be wrong indeed to speak of a candle power of search light, since the illuminating power would be the same at any distance, and the candle power, in the usual definition, infinite.

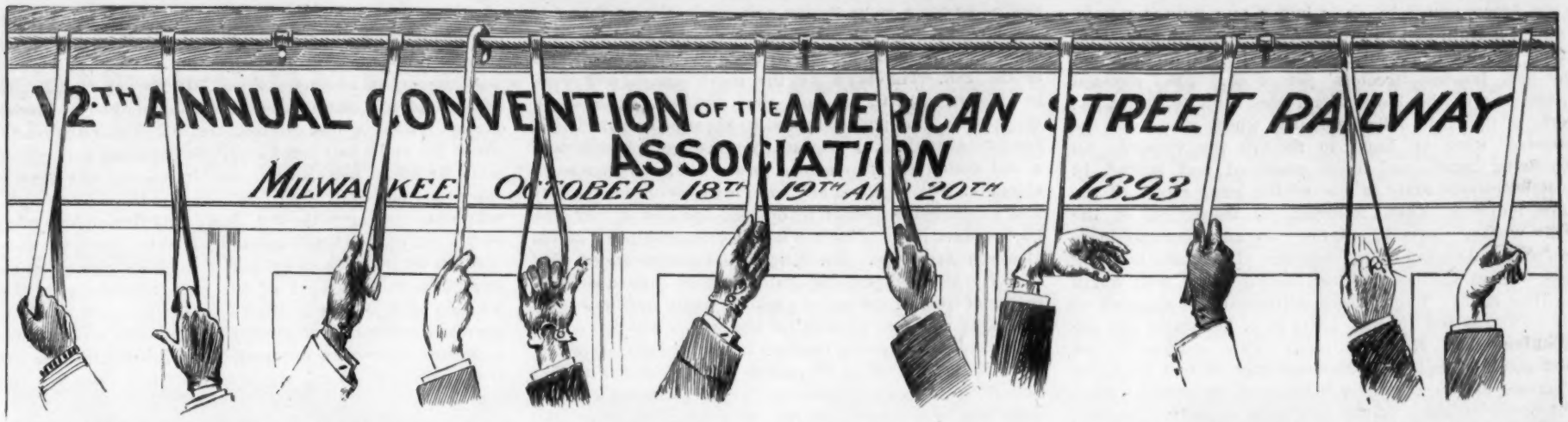
The light rays of a search light are parallel, however, only when reflected from a mathematically true parabolic surface, and emanating from a mathematical point coinciding absolutely with the focus of the parabola.

In reality the source of light is an area of finite extension, the crater of the arc and the reflected rays are in consequence thereof divergent, and the angle of divergence is equal to the angle under which the crater is seen from the centre of the reflector, as a simple reasoning shows.

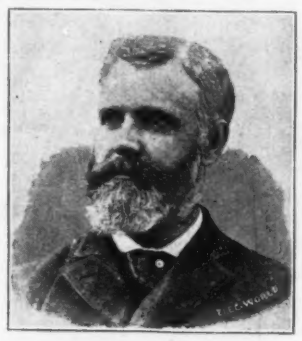
If now, seen from the crater, the reflector subtends an angle of, say, 120 degrees, the whole volume of light given out by the crater within this spherical angle is reflected within the narrow angle of divergence of the reflected beam of, say, two degrees. That means the light is concentrated by the contraction of the illuminated area in the proportion of the squares of the angles 120 degrees and two degrees, that is 3,600 times, and consequently neglecting losses of light in reflection, the intensity of the reflected beam compared with the direct light is increased 3,600-fold. This value is called the multiplying factor of the reflector, and some reasoning shows that it is equal to the ratio of the reflector area to the crater area; that is, in other words, in the reflected beam the light intensity is the same as that of a crater whose diameter is equal to the diameter of the reflector. The rule of estimating the candle power of a search light, mentioned in the Digest, is therefore not an absurd assumption, but based on correct theoretical reasoning; and, as I may add, well proved by photometric tests.

Assuming the candle power of the direct arc as averaging 60,000 in the angle subtended by the reflector, and 3,600 as multiplying factor, we get the candle power of the reflected beam, as $66,000 \times 3,600 = 216$ million candles. Such are the intensities of our modern search lights.

Since the beam of a search light consists of divergent rays, the law of inverse squares holds for the search light, just as well as for any other source of light, and with the same limitation; that is, that this law is the law of distribution from a mathematical point, and therefore holds true for any source of light only in a distance sufficiently large to permit the consideration of the source of light as a point. This distance is greater, indeed, with a search light than with an incandescent lamp.




Street railway men from almost every section of the country, and representing many different interests, gathered in the Assembly Hall of the Milwaukee Industrial Exposition Building at Milwaukee, Wis., on Wednesday, Oct. 18. The occasion was the twelfth annual meeting of the American Street Railway Association, and the number and character of the men assembled there augured well for the success of the convention, and gave assurance that this would prove to be one of the most valuable and interesting of the long series of meetings which have done so much to develop the street railway systems of the United States. Nor were those in attendance to be disappointed, for not only were the reports and papers presented of a high standard, but the discussions which they called forth were participated in by many of the prominent workers in this rapidly broadening field, with gratifying results.



SECY. W. J. RICHARDSON.

In point of numbers, both delegates and supply men, the present meeting was fully up to its predecessors; in fact, the secretary of the association is authority for the statement that more street railway men attended this year than at Cleveland, which has been considered one of the most successful conventions ever held. The only thing to be regretted is that by reason of the unexpected and unavoidable delay on the part of the railroads, many of them principal exhibits intended for display did not reach Milwaukee at all, so that many spaces which had been allotted to important manufacturers remained unoccupied. Notwithstanding this, the number and variety of exhibits made, and the great army of supply men present, gave additional evidence of the generally healthy condition of the electrical industry. It cannot be denied that the recent unprecedented commercial panic through which the nation has passed has had its effect upon this, as well as every other industry, but to the observer who visited the Exposition Building or the corridors of the hotels, there was no sign of depression or word of complaint.

To the street railway officials of Milwaukee too much praise cannot be given for the thoughtful manner in which they planned for the convenience and comfort of their visiting brethren. So far as was in their power, they did everything possible to make the convention the success it proved, and for many a year the souvenir silver spoon, a token of friendship from the newly elected president, Mr. Henry C. Payne, to the visitors, will bring back pleasant memories of the twelfth meeting of the association.

The delegates were very slow in arriving, many of them not reaching their hotels until the morning of the 18th, when everything assumed a business aspect. Such exhibits as had arrived were placed in position the night previous, and when Clauder's band struck up the opening overture in the Exposition Hall every one instinctively felt that another important event in the history of street railway development had been inaugurated.

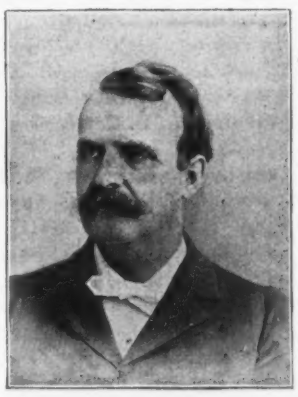
### WEDNESDAY'S SESSION.

The meeting was called to order by President D. F. Longstreet, who immediately introduced Mr. John C. Koch, mayor of Milwaukee.

The mayor gracefully welcomed the members of the association to Milwaukee and extended to them the freedom of the city. He expressed the desire that the convention might be productive of much good, and that those in attendance might be benefited in this way, but might find their visit an enjoyable one as well. He believed that street railways were great factors in our progress; that they relieved the large cities from overcrowding and allowed the spreading of population over widely extended territories, thus giving the people the advantage of suburban neighborhoods.

To this evidence of a cordial reception of the delegates by the citizens of Milwaukee, the president made a brief and appropriate reply, in which he thanked the mayor and assured him that the members of the association would take away from his beautiful city many pleasant memories. He extended to the citizens through the mayor the privilege of inspecting the exhibition of street railway apparatus and appliances, which would no doubt prove interesting as well as instructive.

President Longstreet then delivered his address to the convention. He first expressed his gratitude for the honor conferred upon him by his election to the office which he held, and his deep regret that circumstances had confined him in a section of the country rather remote from the centre of the street railway business interests. He thought that the past year had been a busy one in the work of consolidation and reorganization and progression, and although the financial cloud had hung threateningly over all industries for so many months the street railway business was perhaps affected in a less degree than any other branch employing so large a capital; the millions of dollars invested in urban and suburban transportation is always a safe investment and the dividends always sure to come. Financial panics which appear at irregular intervals necessitate economies of management and he had found it his experience in a period covering nearly 30 years that it was better to keep up the quality of service at such times even at the expense of dividends; a faithful employee, the road-bed and equipment should be the last to suffer; economy should also begin in other directions, including the purchase of supplies, better methods of work, improved appliances, etc., and that was really the chief reason for this association, and why some effort should be made in just such times as the country is now possing through to increase the usefulness of the association. Such a plan was proposed about a year ago, and after careful consideration the Executive committee decided to give an object lesson of that plan at this convention, and therefore arranged for an exhibition on a large scale of all the appliances used in the street railway business. Owing to the financial stringency, and the special exhibits at the World's Fair, this unfortunately had not been as complete as hoped for. The president also called attention to the significance of the statistics as showing what progress had been made in the past decade. He expressed the hope that the delegates would enter fully into the discussions, which he regarded as an important feature of the annual gathering. Intelligent men in the same line of business coming together from all parts of a vast country were sure to get aid from each other. He closed by extending a hearty welcome to those in attendance.



PRES. H. C. PAYNE.

The report of the Executive Committee, which was next read by the secretary, Mr. Richardson, showed that after various consolidations among the members the present membership was 200 companies. The committee considered at some length the formation of the American Street Railway Industrial Institute, and submitted a proposed act of incorporation. In this connection they stated, however, that on account of the financial stress during the present year they believed the time had not yet arrived for the formation of an industrial institute, and they requested that the subject be continued through the committee for another year. They referred to the exhibition in the Milwaukee Industrial Exposition Building as suggesting in a small way what a permanent exposition would be. The committee spoke very favorably of the special reports which had been secured for this meeting, but stated that the usual difficulty had been experienced in securing them in time for advance copies to be prepared and distributed. The exhibitors at the World's Fair and the Exposition authorities were congratulated upon the success with which the Fair had met. The report concluded with a fitting tribute to the memory of James W. Hyatt, Norwalk, Conn; George D. Capen, St. Louis, Mo., and Edward E. Denniston, Philadelphia, Pa., presidents of three of the members of the association, who had died during the year.

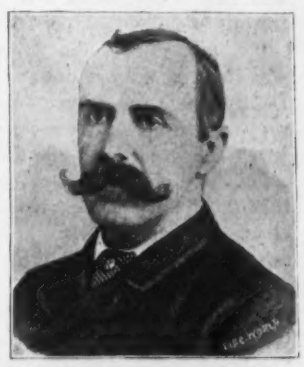
According to the report of the treasurer, which followed, the receipts during the year had been $8,763.77, the expenditures $6,541.48, leaving a balance of $2,222.29.

The report of the Committee on Power House Engines, consisting of E. G. Connette, L. H. McIntire and F. S. Pearson, was then read, an abstract of which will be found in another column. The report favored direct connected compound or triple expansions engines for larger plants, and advocated that all power house machinery should be on the ground floor on heavy foundations. Stress is laid on the necessity of reliable engine governors, on competent professional supervision of a plant and on economy in boiler room practice, and a plan for paying premiums on coal saved by firemen is described.

On the president declaring the paper ready for discussion, Mr. Wm. Richardson suggested that some remarks from the author of the report would be interesting.

Mr. E. G. Connette, in responding, called attention to the fact that the report favored the vertical type of engine and recommended the compound condensing engine for large sized plants. The compound engine got the greatest amount of work out of the steam. The vertical engine takes less floor space and is less likely to have trouble with the piston. He referred to the large compound condensing engine in the power house of the Intramural Railway, at the World's Fair, stating it had never been shut down for repairs to the engine proper, and had hauled 13 trains of five or more cars heavily loaded constantly all day, while the horizontal engines required repairs. The committee appointed to examine engines and award premiums watched the engine work for 23 hours in succession, and running at 100 revolutions, it did not vary probably more than one per cent., even when the load was increased from, say, 50 per cent. to full load. He thought that the question of fuel should be considered carefully, and the plant should be kept up to the efficiency attained at the start, or that secured by the expert who installed the apparatus.

Mr. Arnold, of Chicago, said that he was familiar with the engines at the Fair, and corroborated what Mr. Connette said in regard to the vertical engine in the Intramural power station, but, out of justice to other types, wished to say that the horizontal engines had done almost as well. He believed in vertical engines, but about the greatest drawback to their adoption was the first cost. He thought that it was a mistake to install engines having a rated capacity above that of the generator, and said that the records of the Intramural Railway, and observations made in other plants, proved that the best efficiency was obtained when the engine and generator were of about the same rated capacity; otherwise the engine is operating most of the time at underload and at a decreased efficiency. An engine properly designed could easily stand 50 per cent. more than its rated capacity. He thought that the great difficulty in keeping a plant up to its initial efficiency was the securing of competent men for the wages paid. Replying to an inquiry from Mr. G. G. Browning, of Camden, N. J., as to whether the engines and generator of the Intramural Railway worked at their full capacity, he said that at present there was an excess of power, but that for the first six weeks one engine—the Greene—operated the road alone and was very much overloaded, developing at times as high as 1,700 h. p. In response to inquiries from Mr. Connette he said he did not see any difference in economy between the horizontal and vertical engine, both working under equal conditions, and as to the Corliss or the high speed type he thought the difference was very slight. In the Intramural plant the Corliss engine runs at 90 revolutions, and two of the others at 100; so that the speed is practically the same. He thought that all engines would eventually come to the speed of about 100 to 125 revolutions.



MR. D. F. LONGSTREET.

Immediately upon the noonday adjournment the dele-

gates, accompanied by their ladies and invited guests, boarded a train of gayly decorated special electric cars which had been in waiting at the Exposition Building. The now famous directors' palace car "200," devoted exclusively to the ladies, lead the train to the great works of the E. P. Allis Company, where officials of the company were on hand to receive the visitors. An appetizing lunch had been prepared and spread in most hospitable style in one of the large rooms of the main building. Then followed an inspection of the great works. Covering as they do an enormous acreage, and embracing other branches of machine building than that of Corliss engines, the visit was well worth the time spent. The visitors witnessed the shipping of the giant casting for the 2,500 h. p. generator for the Brooklyn City Railroad plant. This casting is of solid steel, 24 inches in diameter and 28 feet long, the armature of the generator being cast directly to what will form the shaft of the two great engines. Its total weight was 62 tons. It was lifted by the electric traveling crane and carried with ease and rapidity the entire length of the shop and placed on its car ready for shipment.

The party then boarded the train and were driven at full speed over some of the principal streets of the city to the Pabst Brewery, the largest in the world. This visit proved of great interest, particularly that part of the ceremony which involved the sampling of Capt. Pabst's product. Thence the train proceeded to the power house of the company, fully described in our issue of Oct. 21. Here the visitors were pleasantly surprised by the presentation to them of a neat little souvenir descriptive of the plant.

The Wednesday evening session was opened by a discussion by Mr. O. T. Crosby, it being suggested that he give his opinion on the relation of the power required in generators and engine.

Mr. Crosby thought that the real capacity of engines and dynamos was to be dealt with, not the rated; at the present time, however, the rated capacity has come to mean practically the real capacity. He thought that the best practice required that the engine should be no greater in capacity than the dynamo, otherwise it would not work efficiently. Some engineers favored having an engine of a slightly lower rated capacity than the dynamo. As regards vertical and horizontal engines he thought there was no difference intrinsicially in their value, but the vertical engine occupied less space, and space represents money: this, in his opinion, was the meat of this whole question. From an electrical standpoint it was a matter of indifference. He thought that the real estate consideration was the determining element in large plants. This is what determines between condensing and non-condensing engine largely. He had heard a competent engineer recently state that the condensing process when coal is in the neighborhood of $3 per ton may justify an investment of $100 per h. p. to bring it about. He thought the use of belts instead of direct connection was also a question which was one of simple arithmetic and depended entirely upon the matter of first cost, and he did not think it was possible to make any generalization.

The next paper read was the report of Mr. G. F. Greenwood on the best method of lighting and heating street railway cars, an abstract of which will be found in another column. The conclusions arrived at on the best system of heating are the use of an anthracite stove, and, for lighting, incandescent lamps on electric lines or a reliable gas system elsewhere, provided the latter can be operated successfully. The author is in favor of employing one of the five incandescent lights used on electric cars as a head light, two in the lamp boxes at the ends of the car and the other two on the ceiling about four feet from each end.

The report of the Committee on Standards was next in order, but Mr. O. T. Crosby, chairman of the committee, stated that no written report had been prepared. The committee regretted that such was the case, but it was unavoidable. On motion the committee was continued for another year.

"Can T-rails Be Satisfactorily Used in Paved Streets," was the next report called for, but a letter from Mr. C. Densmore Wyman was read regretting his inability to prepare a report. At the request of the president the subject was discussed by the meeting.

Mr. J. Hurt, of Atlanta, opened the discussion. He stated that the T-rail has already become the popular rail in that city and interfered with driving less than any other. The street was paved directly up to the rail, which was laid on a hard pine stringer. Mr. S. Hendrie, of Detroit, stated that a 56-pound T-rail was used in Windsor, Ont., placed in chairs on wooden blocks, the blocks on the outside of the rail being notched on the bottom and sawed off to slant at the top, so that three inches from the rail top of the level of the block is level with the rail. Mr. M. F. Burke, of Terre Haute, said they used a special form of T-rail called the "Shanghai," with brick pavement. The ties were laid on crushed stone, but now a concrete made of the same material with cement was being used. Carriages had no trouble in crossing the rail. Between the brick and the rail a concrete of sand and gravel with cement or a residuum of asphalt was employed; there was no trouble from dirt filling in and no expense in keeping up repairs. Mr. W. F. Carr, of Roanoke stated that he had used 56-pound Philadelphia T-rails on his road with brick paving, the brick on the inside being, molded to come close to the rail, while the surface side was a curve. This plan had worked satisfactorily. The brick on the outside came very near to the same height as the rail. The brick on the inside came from within 1¼ to 1½ inches of the natural surface of the street. This pavement cost $2 32 per square yard. Mr. Longstreet said that a good many years ago he had devised a rail called the Providence girder rail, which was an elongated T-rail without any base; it was seven inches deep and supported on concrete or ties, and had a cast iron base wedged to it. This had been laid in Pawtucket and in Denver extensively. Mr. Wright, of Chicago stated that the city authorities there required them to furnish three inches of iron for the use of vehicles while two inches in width of rail was allowed for the use of the cars. The amount of power used in England in a curved rail, according to Clark, is from 30 to 60 pounds per ton, and with flat rails from 15 to 30, whereas on the T rail with the exposed head the cars frequently ran with three pounds per ton friction. This question of power was an important one. Mr. N. F. Heft, of Bridgeport, was satisfied that the time was not far distant when all city governments would require companies to use T-rails in preference to other types. In Bridgeport they used a 56 pound T-rail with the regulation paving block between the rail, the inside blocks being chipped to fit the rail flange, which was a satisfactory construction. Mr. J. F. Ostrom, of Philadelphia, then moved that a committee be appointed to report not only on the T-rail, but the proper rail for street railway work, and the appointment of a committee on the Standard Rail for Street Railway Use was referred to the Executive Committee.

### THURSDAY'S SESSION.

The report of Mr. C. O. Mailloux on storage batteries in connection with central stations, for utilizing surplus energy for lighting or power, opened the session. After an exhaustive review of the subject and calculations based on actual power station load diagrams, a number of conclusions are arrived at, all in favor of the commercial feasibility of the use of storage batteries in connection with street railway work. An abstract of the report will be found in another column.

Mr. Elmer H. Sperry then read a paper on "Traction and Street Railway Trucks," abstracted in another column, in which he points out the advantages of coupling axles, preferably by bevel gearing, and gave the results of a series of tests made by him.

Mr. O. T. Crosby then introduced Mr. Fritz, of the Bethlehem Iron Works, who, on motion, was invited to address the meeting, but, after thanking the Convention for its courtesy, begged to be excused.

The following gentlemen were then appointed by the president as a nominating committee to select officers for the ensuing year, and the place for the next meeting: Messrs. Lang, Toledo, O.; Bean, St. Joseph, Mich.; Baumhoff, St. Louis, Mo.; Rugg, Pittsburgh, Pa.; Stephenson, Washington, D. C.; Lusher, Montreal, Ont., and Perrine, Trenton, N. J.

At the afternoon session Mr. C. J. Field first read a paper on "Direct Driven Generators," in which the various advantages of direct driving were considered, five of the principal types of generators now in use being taken as examples, and their construction and individual advantages briefly outlined. The power-house engine also came in for a share of consideration, and Mr. Field favored the vertical modified marine type, expressing his belief that all things considered even the first cost of a station equipped with these engines would not be materially different from one supplied with horizontal engines.

Mr. W. E. Harrington, of Camden, N. J., on motion, was accorded the privilege of reading a paper on street car magnetic cut-outs, in which the advantages of the same are pointed out and reference made to a type of cut-out invented by the author. The same subject is considered at greater length in an interesting article by Mr. Harrington in The Electrical World of April 29.

The following companies were announced by the secretary as having become members of the association: Calumet Electric Railway Company, Chicago, Ill.; Marinette Electric Light and Railway Company, Marinette, Wis., and the New Orleans Traction Company, New Orleans, La.

Chairman Lang, of the nominating committee, reported that the following officers were recommended by the committee: President, Henry C. Payne, Milwaukee, Wis.; first vice-president, W. J. Stephenson, Washington, D. C.; second vice-president, James R. Chapman, Grand Rapids, Mich.; third vice-president, Lewis Perrine, Jr., Trenton, N. J.; secretary and treasurer, W. J. Richardson, Brooklyn, N. Y.; executive committee, D. F. Longstreet, Denver, Colo.; Thos. H. McLean, Indianapolis, Ind.; Edward Whittaker, St. Louis, Mo.; W. Y. Soper, Ottawa, Canada; E. S. Goodrich, Hartford, Conn. They were unanimously elected by the Convention.

Chairman Lang then announced that the committee had decided to recommend the acceptance of the invitation of Mr. Hurt, of the Atlanta Consolidated Street Railway Company, Atlanta, Ga., to hold the Convention in that city next year, and upon motion this recommendation was adopted by the Convention. Mr. Lusher, of Montreal, extended a very hearty invitation to the Association to hold its meeting in that city the year after next, and gave the assurance that there were ample accommodations for all those who cared to attend.

President-elect H. C. Payne was then escorted to the chair by Messrs. Lang and Rugg, and after being introduced by President Longstreet briefly thanked the Convention for the honor conferred upon him.

At the request of the president, Mr. Herbert Claude gave an account of the practical operation of the Love underground system in Washington. He stated that the road is about one and a half miles long, and had been in operation since the 4th of last March, and it has run satisfactorily since that date until now. In regard to the conduit filling with snow, owing to the slot being only five-eighths of an inch wide, there is little probability of this; but if the snow does get in, it can be swept out in the same manner as the conduit is now cleaned of dirt. An advantage in cold weather is, if the rails are covered with sleet or ice the operation will not be effected, as in the trolley system, since a grounded current is not used. Mr. Claude thinks the system a great success on the one-and-a-half mile line, and sees no reason why it should be otherwise on longer lines.

Mr. M. D. Law, at the request of the president, also described the underground conduit system which he had constructed at Washington, D. C.

The following resolution was then moved and carried:

Resolved, That the Executive Committee be requested to draught a suitable memorial to the various State legislatures and municipalities, asking them on behalf of the American Street Railway Association to enact laws to prohibit the common practice of children jumping on and off moving cars, and that copies of the same be furnished each member company of this Association.

A motion was made and carried that the convention return its thanks to the Milwaukee Street Railway Company and the various enterprising men in the city who have extended special invitations, for their kind and hospitable treatment while the convention has been in session.

The convention was then adjourned to meet at Atlanta, Ga., one year from date.

### THE BANQUET.

The annual banquet was held in the dining hall of the Hotel Pfister on Thursday evening, and about 250 guests were present. The hall was beautifully decorated and there was an abundance of floral display and good music. An interesting feature was the presentation by Mr. H. C. Payne, Esq., of the Milwaukee Street Railway, of a souvenir spoon to each one present. Mr. D. F. Longstreet acted as toastmaster and the toasts were as follows: Transportation and Civilization, Hon. J. G. Flanders; Street Railway Employees and the Public, Hon. Ogden Fethers; The Earlier Days and Methods of Street Railways, Hon. Winfield Smith; My Electric Sweetheart, a poem, J. H. Stedman; The Press, Horace Rublee; Street Railway Men, Past, Present and Future, H. H. Windsor. Remarks were also made by Wm. Richardson, Hon. George W. Peek and Henry C. Payne.

### THE STREET RAILWAY DELEGATES.

Armstrong, E. A., Camden, N. J.
Adkins, James, St. Louis, Mo.
Ashton, Jr., S. K., Milwaukee, Wis.
Ahearn, T., Ottawa, Canada.
Atkinson, J. M., Burlington, Ia.
Bradley, E. A., Waterbury, Conn.
Baumhoff, G. W., St. Louis, Mo.
Brenner, W. H., Montreal, Canada.
Bickford, J. H., Scranton, Pa.
Baker, N. F., Washington, D. C.
Brown, F. Wayland, Youngstown, O.
Burt, T. M., Berlin, Ont.
Binner, E., Dayton, O.
Bartlett, A., Los Angeles, Cal.
Bimmelinger, Julius, Milwaukee, Wis.
Becker, Danforth, Milwaukee, Wis.
Bailey, T. P., Kalamazoo, Mich.
Bean, W. W., St. Joseph, Mich.
Bowen, M. K., Chicago, Ill.
Belden, D. A., Aurora, Ill.
Bradford, H. P., Cincinnati, O.
Blum, Isaac, Philadelphia, Pa.
Brown, R. S., Gloucester, Mass.
Burke, M. F., Terra Haute, Ind.
Breed, Amos F., Boston, Mass.
Browning, G. G., Camden, N. J.
Ballard, W. J., Dubuque, Ia.
Connette, E. G., Nashvile, Tenn.
Carpenter, Reid, Mansfield, O.
Charlton, B. E., Hamilton, Ont.
Candee, John C., Bangor, Me.
Crosby, O. T., Wilmington, N. C.
Colliander, A., Chicago, Ill.
Christopher, J. M., Baltimore, Md.
Carr, W. F., Roanoke, Va.
Conovers, C. C., Hot Springs, Ark.
Cameron, W. S., Jamestown, N. Y.
Clegg, C. B., Dayton, O.
Corwin, D. B., "
Crawford, R. C., Chicago, Ill.
Candee, Leverett, New Haven, Conn.
Crossman, T. E., Brooklyn, N. Y.
Clark, E. P., Los Angeles, Cal.
Crowley, H. J., Atlanta, Ga.
Colby, F. L., Rockford, Ill.
Dixon, H. A., Port Huron, Mich.
Degen, N. E., Manistee, Mich.
Durnin, T. J., Milwaukee, Wis.
Doremus, H. M., Bridgeport, Conn.
Delaney, W. H., New York.
Dunning, Robt., Buffalo, N. Y.
Durbin, C. K., Denver, Colo.
Dean, W. W., Hamilton, Can.
Dickson, W. D., Great Falls, Mont.
Dixon, A., Port Huron, Mich.
Derr, D. A., Charlotte, N. Y.
Duncan, E., Dubuque, Ia.
Dean, J., Hamilton, Ont.
Downs, E. E., Kalamazoo, Mich.
Davis, N. A., Cincinnati, O.
Everett, H. A., Cleveland, O.
Edwards, Frank, Lincoln, Neb.
Ellis, C. E., Philadelphia
Elliott, Miller, Pittsburgh, Pa.
Fenimore, Francis, Phœnixville, Pa.
Frenyear, T. C., Gloversville, N. Y.
Flynn, C. E., Peoria, Ill.
Foster, E. C., Boston, Mass.
Ferguson, W. B., Haverhill, Mass.
Flesh, L. M., Piqua, O.
Frederick, C. R., Davenport, Ia.
Fraser, J. D., Ottawa Can.
Fritz, John, Bridgeport, Conn.
Fry, J. H., Detroit, Mich.
Foster, W. H., Pittsburgh, Pa.
Gottschall, W. C., Muncie, Ind.
Glass, Andrew, Washington, D. C.
Goodwin, W. W., Detroit, Mich.
Goodrich, E. S., Hartford, Conn.
Greenwood, G. F., Pittsburgh, Pa.
Grover, T. F., Milwaukee, Wis.
Guyer, B. H., Moline, Ill.
Green, Alfred, Rochester, N. Y.
Gorman, John B., Worcester, Mass.
Green, Frank B., Chicago, Ill.
Greer, J. W., San Antonio, Tex.
Griffin, W. H., Galveston, Tex.
Goodrich, C. E., St. Paul, Minn.
Grant, John, Detroit, Mich.
Gunn, James, Toronto, Canada.
Haynes, George D., Newark, N. J.
Hurt, Joel, Atlanta, Ga.
Haynes, J. E., Newark, N. J.
Holbrook, E. M., Cedar Rapids, Ia.
Hilgard, F. T., Milwaukee, Wis.
Halm, C. W., " "
Hubbard, F. C., " "
Howell, T. E., Dayton, O.
Hayward, A. H. Allentown, Pa.
Hatch, W. S. Detroit, Mich.
Hendrie, S., " "
Hoffman, J. F., Milwaukee, Wis.
Heft, N. F., Bridgeport, Conn.
Henry, D. F., Pittsburgh, Pa.
Hager, W. S., Wilmington, Del.
Hay, A. E., Chambersburg, Pa.
Hulsizer, John, Joliet, Ill.
Haven, W. E., Fishkill, N. Y.
Harrison, Russell B., Terre Haute, Ind.
Hayes, Henry, New Britain, Conn.
Hawks, J. D., Detroit, Mich.
Hurley, P. E., Trenton, N. J.
Ives, E. B., Philadelphia, Pa.
Jenkins, T. M., Covington, Ky.
Jewell, W. S., Anderson, Ind.
Jones, F. G., Memphis, Tenn.
Johnson, J. W., Kalamazoo, Mich.
Jones, W. E., St. Louis, Mo.
Keithley, H. R., Chicago, Ill.
Kilgour, B. L., Cincinnati, O.
Klinkerfus, H., Milwaukee, Wis.
Klau, G. W., " "
Kelbe, J. W., Baltimore, Md.
Kelly, W. T., Columbus, O.
Kelsey, I. A., New Haven, Conn.
Knowles, P. L., Phœnixville, Pa.
Kingston, W. W., Montgomery, Ala.
Lea, Preston, Wilmington, Del.
Lang, Albion E., Toledo, O.
Law, M. D., Washington, D. C.
Luther, C. F., Pawtucket, R. I.
Lynn, A. W., Milwaukee, Wis.
Lusher, E., Montreal, Canada.
Lockey, Richard, Helena, Mont.
Littell, H. M., New Orleans, La.
Lipper, M. W., Philadelphia, Pa.
Littell, H. H., Buffalo, N. Y.
Longstreet, D. F., Denver, Colo.
Lawless, E. J., Paterson, N. J.
Liggett, J. C., Detroit, Mich.
McLean, T. H., Indianapolis, Ind.

McNamara, J. W., Albany, N.Y.
Morse, Geo. C., Taunton, Mass.
McLaughlin, C., Paterson, N. J.
Melms, C. J., Milwaukee, Wis.
McNaughton, A.,
McCloskie, C. H., Chicago, Ill.
May, J. M., Dubuque, Ia.
Meslin, G. W., Brooklyn, N. Y.
Minary, C. K., Springfield, Ill.
Minary, J. S., St. Louis, Mo.
Macfarren, L. J., Pittsburgh, Pa.
McIntyre, L. H., Philadelphia, Pa.
Marks, Ferdinand, Philadelphia, Pa.
McCartney, J. L., Norfolk, Va.
McClory, J. B., Birmingham, Ala.
Morris, H. W., Milwaukee, Wis.
McCulloch, Robert, St. Louis, Mo.
McKinney, C. A., Houston, Tex.
Markle, A., Hazleton, Pa.
Morton, H. T., Ann Arbor, Mich.
Rigg, J. A., Reading, Pa.
Rugg, J. E., Pittsburgh, Pa.
Radel, Andrew, Newark, N. J.
Rogers, Lewis H., Cleveland, O.
Reed, G. F., Springfield, Mass.
Shepardson, A. C., Waterbury, Conn.
Smith, Walter C., Milwaukee, Wis.
Smith, Clement C., La Crosse, Wis.
Sullivan, D. W., Brooklyn, N. Y.
Scullin, Harry, St. Louis, Mo.
Schloss, S., Detroit, Mich.
Smith, A. P., New Bedford, Mass.
Sinclair, H. B., Galveston, Tex.
Sullivan, P. T., Lowry, Mass
Sterling, J. R., Detroit, Mich.
Stephenson, W. J., Washington, D. C.
Stone, A. L., Oakland, Cal.
Sperry, E. A., Cleveland, O
Scull, W. S., Camden, N. J.

AMONG THE EXHIBITORS.

J. S. SPEER presented the claims of the Partridge Carbon Company, of Sandusky, O.

THE WESTERN ELECTRIC COMPANY, of Chicago, had an attractive exhibit of line wire and specialties.

THE STANDARD OIL COMPANY, by Mr. F. E. Carleton, Milwaukee agent, made a very attractive display of lubricating oils.

THE UNITED STATES PROJECTILE COMPANY, of Brooklyn, N. Y., had a fine display of their patented hot pressed steel motor gears.

E F. WICKHAM, secretary of the St. Louis Register Company, had a splendid display of his "Surety" registers that was much admired.

THE JOHN STEPHENSON COMPANY, of New York, had all other raw hide!" was the declaration over the exhibit of the New Process Raw Hide Company, of Syracuse. Their exhibit was very popular.

BABCOCK & WILCOX BOILERS, while not having any material exhibit, were well and ably represented by Messrs. E. S. Wells, of the New York office, and Mr. Chas. Wilson, of the Minneapolis branch.

HOWARD WHEELER AND J. HENRY CARSON handled the interests of the Sterling Supply Company in an effective manner. Their exhibit was one of the first to be completed, and received much attention.

J. S. DOUGLASS was in charge of the neat little display made by the Union Electric Company, of 45 Broadway, New York City. This showed specimens of the anti-friction metal bearings made by the Union Company.

TRUCKS EMBOWERED IN PALMS.

HOW MR. McELROY PROPOSES TO MAKE IT HOT FOR STREET CAR PASSENGERS.

McQuaid, J. P., Norristown, Pa.
Mailloux, C. O., Washington, D. C.
McGiffert, J. S., New Britain, Conn.
McCartney, L. F., Norfolk, Va.
Mendell, C. S., New Bedford, Mass.
Mock, H. A., Brooklyn, N. Y.
Murphy, Michael, Brooklyn, N. Y.
MacDonald, C. F., Ottawa, Canada.
Martin, Edward, Hamilton, Ont.
Mason, W. L., Milwaukee, Wis.
Ostrom, J. F., Steelton, Pa.
Odell, Chas., Newburyport, Mass.
Pierson, C. H., St. Louis, Mo.
Patterson, W. H., Bloomington, Ill.
Partridge, John N., Brooklyn, N. Y.
Phillips, George, A., Milwaukee, Wis.
Penington, T. C., Chicago, Ill.
Swift, C. M., Detroit, Mich.
Shewmon, Allen, Racine, Wis.
Shaw, E. P., Jr., Norwich, Conn
Scheerer, W., Newark, N. J.
Smith, W. H., Omaha, Neb.
Sullivan, J. J., Philadelphia, Pa.
Shelmerdine, W. H.,
Smith, W. C., Pittsburgh, Pa.
Stern, W. A., Philadelphia, Pa.
Shaffer, W., Asbury Park, N. J.
Shaw, E. P., New Haven, Conn.
Sargent, W. W., Fitchburg, Mass.
Shaw, J. F. Newburyport, Mass.
Traggard, J. G., Pittsburg, hPa.
Tindolph, E. F., Vincennes Ind.
Ticknor, F. A., Rockford, Ill.
Thompson, A. C., St. Louis, Mo.
Upham, C. C., Lincoln, Neb.
Valentine, John, Portland, Ore.
Winsor, Paul, Boston, Mass.
Williams, Chas. H., Manchester, N. H.
Williams, Chas. A., Rochester, N. Y.

two interesting and hustling representatives in Messrs. J. A. Takaberry and E. W. Pugh.

AGENT J. I. WHITE, of the Bass Foundry and Machine Company, Fort Wayne, Ind., was one of the visitors who had no other exhibit than himself and the name of his famous house.

THE LAPPIN BRAKE SHOE COMPANY, by Representative Graham, pleased its host of friends by presenting a neat and serviceable pocket memorandum book. It had no other exhibit.

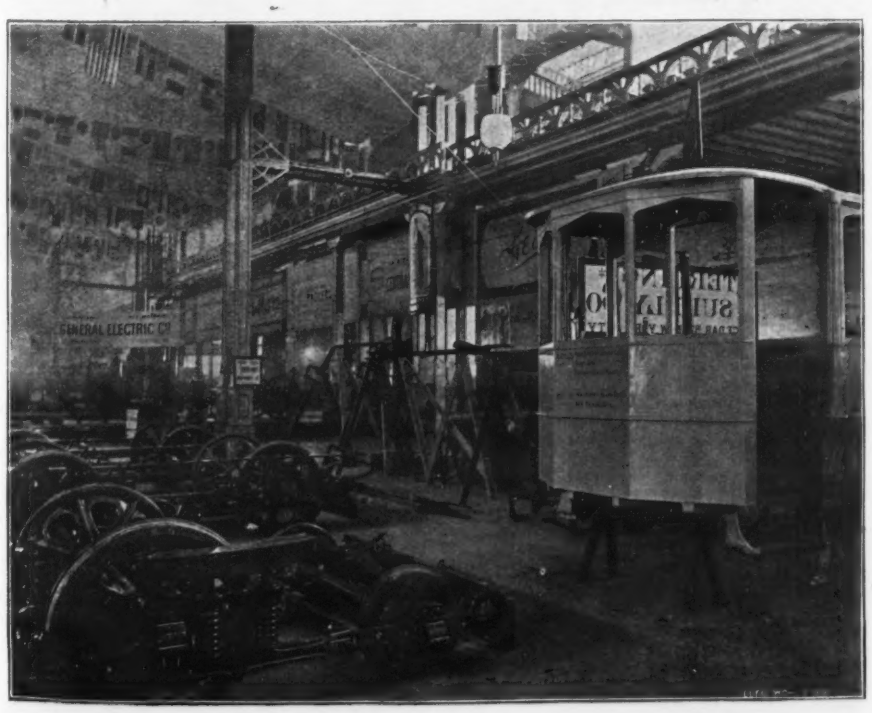
J. S. CRIDER, secretary of the Washington Carbon Company, of Pittsburgh, Pa., was one of the very few carbon men present. He was accordingly very busy among the delegates.

THE GIBBS ELECTRIC COMPANY of Milwaukee,

UNDERGROUND ELECTRIC CONDUITS had only one claimant for convention honors, the Love Electric Traction Company, of 817 The Rookery, Chicago. M. D. Law, the well known electrical engineer, was their representative.

JONES & LAUGHLINS, Limited, owners of the American Iron and Steel Works, at Pittsburg, with a Chicago office at Lake and Canal streets, were represented by Mr. Roland Gerry, from the home office, and Mr. P. C. Goble, of Chicago.

A. L. IDE & SON, of Springfield, Ill., makers of the "Ideal" and "Ide" engines, had a good display in the person of their Mr. Willis H. Post. He was here, there and everywhere, pressing the claims of his well known engines.




A CHARACTERISTIC VIEW IN THE EXHIBITION HALL.

AN EXHIBIT THAT ATTRACTED MUCH ATTENTION.

Pidd, Thomas, Milwaukee, Wis.
Perrine, Jr., Lewis, Trenton, N. J.
Pratt, Mason D., Steelton, Pa.
Perrin, H. P., Trenton, N. J.
Potts, H. T., Philadelphia, Pa.
Payne, H. C., Milwaukee, Wis.
Peck, Frank C., Kansas City, Mo.
Richardson, William, Brooklyn, N. Y.
Rommell, W. D., Pittsburgh, Pa.
Routzohn, M. H., Dayton, O.
Rusling, T. O., Chicago, Ill.
Richardson, W. J., Brooklyn, N. Y.
Rogers, H. B., Brockton, Mass.
Reed, W. P., Salt Lake City, Utah.
Wright, L. R., Denver, Col.
Ward, Elias S., Newark, N. J.
Wood, H. H., Birmingham, Conn.
Whitehead, H. C., Norfolk, Va.
Woods, Henry F., Boston, Mass.
Wightman, M. J., Middletown, N. Y.
Woodruff, R. S., Trenton, N. J.
Wheeler, G. K., Kalamazoo, Mich.
Whitney, F. H., Milwaukee, Wis.
Yeales, R. H., Chicago, Ill.
Young, A. M., New Britain, Conn.
Woodman, Franklin, Haverhill, Mass.
Wheeler, Geo. F., Dubuque, Ia.

Wis., distributed some neat colored leaflets giving prices of their railway material. These little flyers were much in demand.

R. H. NUTTALL COMPANY, of Pittsburgh, Pa., had in the person of Mr. J. M. Denniston, general agent with office in the Monadnock Block, Chicago, a hustling and business-like representative.

THE NEW YORK INSULATED WIRE COMPANY did not exhibit, but were wise in sending to Milwaukee for the convention their Chicago agent, Mr. James B. Olson, who made many friends.

AS STEEL IS TO IRON so is New Process raw hide to

THE RAILWAY EQUIPMENT COMPANY, of Chicago, in charge of Manager W. R. Mason, circulated some very effective literature. Their headquarters at the Plankinton were well patronized by street railway men as well as scores of visitors.

THE FULTON FOUNDRY COMPANY, of Cleveland, exhibited a truck that created genuine interest because of its novelty of design. Mr. W. E. Haycox, manager of the railway department of this company, was one of the busiest men at the convention.

A. N. LOPER AND F. COLEMAN BOYD were in charge of the neat exhibit of street car registers

made by the New Haven Car Register Company, of New Haven, Conn. This register has had a wide introduction in electric railway cars.

The Hope Electrical Appliance Company, of Providence, R. I., sent Mr. A. W. Wright, who has so admirably handled their World's Fair display. He proved himself to be a most efficient representative, and was kept busy all the time.

The Pullman Electric Company, of 44 South Jefferson street, Chicago, had cards out announcing that they make a specialty of "Rewinding and repairing electric machinery," as well as giving particular attention to "Motor and dynamo inspection."

The Cummings & Engleman Conduit Company, was everywhere present pushing the claims of his well-known boiler.

Harrison & Carey, of Chicago, made a compresive display of the solid mica insulators manufactured by the W. T. C. Macallan Company, of 416 Atlantic avenue, Boston, Mass. This is but one of the lines of railway material handled by this enterprising firm. Partner Carey was in charge.

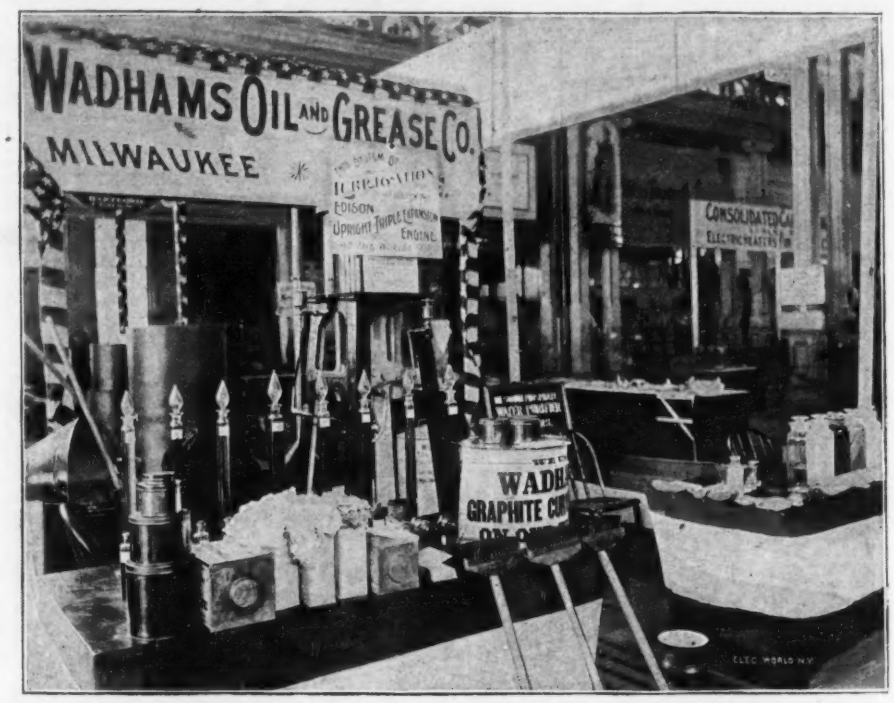
The Edison Manufacturing Company, of 110 East Twenty-third street, New York, had a unique display of the Kennelly patented electrostatic voltmeters and ammeters, as well as several cells of the famous Edison-Leland primary battery. Mr. J. W. Gladstone, manager of the company, was in charge.

trical Installation Company, Monadnock Building, Chicago, in which enterprise he has met with great success.

R. A. Crawford, inventor of a very clever automatic wheel guard and pick-up fender, and president of the R. A. Crawford Manufacturing Company, with offices at 35 Water street, Pittsburgh, Pa., had an interesting exhibit of his device, which attracted considerable attention from the street railway managers present.

The Scott Car Spring Company, of Philadelphia, gave away a very handsome little pocketbook souvenir that was much sought after. Their exhibit was one of the neatest in point of decorations in the hall. Mr.

HOW CARS ARE TO BE HEATED BY ELECTRICITY THIS WINTER.




A CREAM CITY EXHIBIT THAT WAS NOT CREAM.

of Detroit, Mich., made a very neat display of samples of their Cummings underground conduit. Mr. E. M. Engelman was in charge of the exhibit, while Mr. James F. Cummings was busy among the delegates.

The Jewell Belting Company, of Hartford, Conn., had a neat exhibit of their well known belts. Manager C. E. Newton stuck close to business, supplying his many callers with a handsomely embossed pamphlet as a souvenir of the convention.

The Brownell Car Company, builders of street cars, were ably represented by Mr. F. B. Brownell himself, assisted by Mr. Wilbur B. Allen. As this firm have a very interesting exhibit at the World's Fair, it was not deemed necessary to make one at Milwaukee.

Valentine & Company, the world famous varnish manufacturers, had their equally famous agent, Mr. S. F. Miller, on exhibition. Mr. Miller has made many friends among not only electric railway managers, but builders of electric cars, and finds a ready market for his product in this ever-increasing field of work.

Hawley Down Draft Furnace Company, with headquarters in the Security Building Chicago, had an excellent representative in the person of Mr. W. F. Tatnall, who registered at the Pfister. This furnace is gaining a great reputation for itself in all the electric stations and power plants where it has been introduced.

The Tousley Trolley, manufactured by the Tousley Trolley Company, of 139 Fifty-third street, Chicago, Chas. Scott, Jr., manager of the company, assisted by Mr. H. C. Johnston, was in attendance throughout the convention.

The Reliance Gauge Company, of Cleveland, O., had an interesting exhibit of their Reliance safety water column. Mr. Geo. B. Clark was in charge. During the convention he sold to the Stirling Company 100 water columns for use on the well known Stirling boilers. This was one of the best sales recorded at Milwaukee during the week.

Eureka Tempered Copper, the product of the Eureka Tempered Copper Company, of North East, Pa., was well in evidence. The company had a very large display of copper segments and the other copper work

ONE OF THE BOOTHS READY FOR INSPECTION OF THE DELEGATES.

THE LARGEST BELT IN THE WORLD IN ACTUAL OPERATION.

Cooolidge, Evans & Littlefield, the great trio representing the Johnson Steel Company, of Johnstown, Pa., were the most observed of all the supply men, not only because of their attention to regular business, but by reason of their exceptional behavior.

The Garton Lighting Arrester was an exhibit that attracted a crowd. One of the arresters was in service upon a live wire, and every time it broke the circuit there would be a flash noticeable from every point. Its perfect operation created a most favorable impression.

The Stirling Company, of Chicago, were disappointed on account of not having their handsome model on exhibition. By the error of some railroad employee this failed to arrive; but Secretary Thomas Deegan was a new-comer that was well received. The claims of this trolley are that it is "Continuous self-lubricating, throws no grease or oil, has no detachable guards, nuts or bolts, and does not leave the wire at curves."

Stern & Silverman, a name associated with electric railroading from the early Sprague days, for awhile changed, owing to changes in the Edison interests, and now reincorporated at Philadelphia, was brought to the notice of every one by the presence of Mr. Stern. He reports business as excellent, with a very bright outlook.

L. E. Myers, for many years a prominent figure at street railway conventions, was much in evidence, not only at the hotels, but about the Exposition Building. Mr. Myers is now secretary and treasurer of the Elec-furnished street railways. Agent John R. Coffman kept all the visitors aware of the fact that his display was well worthy of their attention.

The McGuire Manufacturing Company, of Chicago, manufacturers of one of the best known electric trucks on the market, was represented, first and most important, by Mr. W. A. McGuire himself and Messrs. Hanna and Cook. With so many of their trucks in actual service in the city of Milwaukee, it was unnecessary to make any other display.

A Milwaukee Exhibit that attracted attention was that made by the Wisconsin Electrical Construction Company, of 451-453 Broadway, Milwaukee. It showed a very neat line of overhead material and street railway specialties. Mr. Frank J. Morawetz, president

of the company, and Mr. W. N. Stewart, manager, were in attendance at the convention.

THE STANDARD RAILWAY SUPPLY COMPANY, of Chicago, under the charge of Mr. Garson Myers, had what was acknowledged to be one of the most complete exhibits made. He had arranged a number of his car heaters in such a way as to form a side wall, while in front, on a sort of counter was displayed a full line of the overhead material furnished by this house.

THE MIAMISBURG ELECTRIC COMPANY, of Miamisburg, O., had a complete line of both the Burnley Cartridge and Imperial Dry batteries on exhibition, as well as some splendid samples of tempered copper. The exhibit was in charge of Mr. D. H. Allen, secretary of the company, and Mr. Daniels. A description of these batteries will be given in a subsequent issue.

THE FILER & STOWELL COMPANY, although having a most complete and interesting factory in the city, supplemented this by having present at the convention Mr. G. F. Wheeler. This company, in addition to building engines, now manufacture the Milwaukee friction clutch pulleys and couplings, as well as a complete line of power transmission machinery.

"GRAHAM'S TRUCK" was right in line. Inventor J. H. Graham was personally in charge, and was one of the busiest men on the floor. His neat little folders on "Electric Trucks and Spring Suspension" stated the claims of his truck in a most convincing manner. Both he and his exhibit created plenty of talk that would have been gratifying to him had he heard it all.

ELECTRIC CAR HEATING was well illustrated by the exhibit of the Consolidated Car-Heating Company, of Albany, N. Y., in charge of Engineer J. F. McElroy. He had arranged a section of street car seats under which were placed electric heaters to demonstrate their practicability and adaptibility to any existing car. This exhibit was a favorite one for visitors.

The MIAMISBURG ELECTRIC Co.
THE BURNLEY CARTRIDGE BATTERY
THE ONLY PURE TEMPERED COPPER EXHIBITION HERE.
IMPERIAL DRY BATTERY.
NO LOCAL ACTION
NO DEAD Batteries.

ONE OF THE BEST TEMPERED EXHIBITS AT THE CONVENTION.

THE SPERRY ELECTRIC RAILWAY COMPANY, of Cleveland, O., was represented by Mr. Elmer H. Sperry, inventor of the one-motor Sperry system. This motor has pulled 5,000 pounds up a 12 4-10 per cent. grade before judges at the World's Fair, dynamometer test, before wheels slipped, no sand being used. It is claimed that in the same test a double motor equipment pulled only 2,500 pounds on the same grade.

CHAS. A. SCHIEREN & COMPANY was an old-time name swung above an interesting belt exhibit on the main aisle. In addition to many fine samples of belting, rubber coats, jackets and gloves for motormen were displayed. Mr. Schieren himself is busy at home, being engaged in an exciting mayoralty canvass in Brooklyn, N. Y., as mentioned in The Electrical World last week. The company was, however, ably represented at the convention by R. W. Grant.

"THE TEN ARC LAMPS UNDER THE GALLERY," as stated in the memorandums distributed throughout the hall, were those of the Mosher pattern, well known among street railway men for their excellent operation on street railway circuits. The ten lamps referred to were burning on the regular circuit, and worked admirably. J. A. Sheriffs was in attendance, and found many old friends ready to congratulate him on the showing his lamps made.

LINK BELT MACHINERY, manufactured by the Link-Belt Machinery Company, was brought forcibly to the attention of the delegates during their visit to the power station of the Milwaukee Street Railway Company, where a most complete system of coal and ash handling machinery was in operation. In addition to this the company made a good exhibit in the Exposition Building. President Turner was in charge, and Consulting Engineer S. B. Peck did the expert talking.

THE CURTIS ELECTRIC MANUFACTURING COMPANY had one of the only two exhibits which were shown in operation. Its rival was that in the General Electric Company's space, just across the aisle. The Curtis motor certainly made a most impressive showing in this exhibit. Started, run at half speed, then full, then reversed instantly, and started forward again, it caught the fancy of the visitors, and always had a crowd about it. It was admitted to be one of the most popular exhibits in the hall.

WIRE GLASS, the product of the American Wire Glass Manufacturing Company, of which Mr. H. M. Thompson, formerly secretary of the Brooklyn City Railroad Company, and Thomas B. Inness, formerly manager of the Manhattan Equipment Company, are agents, was an exhibit of particular interest. The samples shown gave a good idea of the value of this new glass for use in constructing electric stations and power houses. Mr. W. H. Delany was in charge of the exhibit.

"WHT IS LIFE WITHOUT A LIVER?" was the startling question asked the passer-by in the little fly-leaf supplied by the Heine Safety Boiler Company. The question was explained by the statement that "Good boilers are to a power plant what high-grade digestive apparatus is to the human system." Then followed some of the claims of this popular boiler. These little leaflets were well received. Col. E. D. Meier, president of the company, was present in person at the convention.

'NOT SO COLD AS IT IS, WAS IT?" was the rather mixed legend above the display of the Robinson Machine Company, of the Drexel Building, Philadelphia; but while many were in doubt as to the meaning of this peculiar expression, no one seemed to question the favorable impression created by the handsome black painted truck of this company resting on a pure white ground. Messrs. Albert E. Hay, president of the company, and his brother, Mr. W. H. Hay, attended to supplying information.

SIEMENS & HALSKE ELECTIC COMPANY, of America, with headquarters at Chicago, enjoyed the distinction of having one of the most notable exhibit at the convention. This consists of a 500-h. p. street railway generator in actual service. A tent had been constructed for the purpose outside of the building, and temporary pipes took steam to the engine from the power house. It was a bit of enterprise greatly commented upon. The company were represented by Messrs. A. W. Wright, A. Von Babe, W. N. Stewart, H. M. Kerby and C. D. Shain.

THE LEWIS & FOWLER exhibit included an electric street sweeper, one of three built for the Milwaukee lines; a cable sweeper, one of eight built for the West Division line, Chicago, and one road sweeper. Also a handsome street car, being one of 50 built for the Brooklyn City Railway Company. Representatives of the company present were Messrs. Geo. W. Myers, Chas. S. Mead, Frank Morrell, Wm. C. Wood, Louis E. Robert, T. Griscoll, and H. C. Simpson. They had open house at both the Pfister and Plankinton hotels.

THE CUTTER ELECTRICAL AND MANUFACTURING COMPANY, of 27 South Eleventh street, Philadelphia, had an effective exhibit of their C–S automatic magnetic cut-out, which has already been described at length in these columns. This novel device is being rapidly introduced into street railway circuits because of its extreme simplicity and perfect operation. Mr. W. E. Harrington, inventor of the device, and electrical engineer of the Camden, N. J., Railroad Company, was at his post almost continuously during the meeting.

THE WINKLER TWIN MOTOR, manufactured by The United Columbian Electric Company, of Philadelphia, Pa., and 280 Broadway, New York City, had as its principal representative Mr. H. W. Weller, one of the oldest electric railway men in the business. Mr. Weller was with the Sprague Company almost from its inception, and more recently has been with the railway department of the General Electric Company. He has taken charge of the Winkler motor, believing, as do many others, that it enjoys superior advantages. Mr. Weller was kept busy greeting old friends, and receiving hearty well wishes on his new venture.

WADHAM'S OIL AND GREASE COMPANY, of Milwaukee, treated the convention to a novelty in the way of exhibits. In addition to their very complete and interesting display in the exhibition hall, they had men in uniform at nearly every street railway curve in the city applying their curve grease with patented brushes. They were also fortunate in securing space in many of the car windows for their signs announcing the fact that their product was used on all the street car lines of the city. Messrs. Geo. A. Streeter and J. M. Campbell were kept busy with visitors and delegates seeking information and asking for prices.

AMERICAN CAR HEATERS had the largest booth at the convention. The display was under the auspices of the Central and Western Electric Heating companies, and was one of the most complete in the building. Mr. Geo. Cutter, of Chicago, represented the Western company, while Mr. Edw. B. Wyman, of New York, filled a like office for the Central. While at the convention Mr. Wyman received a telegram from the home office as follows: "Have closed order for 200 cars, style B, for Brooklyn; conditions, prompt delivery." In addition to this, orders were left at the exhibit for more than 50 car equipments.

"MICANITE" was the only familiar name flashed upon the visitors through an illuminated sign, although this method of advertising is a favorite one at exhibitions. The exhibit of the Mica Insulator Company, 218 Water street, New York, was one of the most noticeable of all the displays. It was well located and admirably designed. It included "micanite" sheets 36 by 36, of all thicknesses, slot troughs for all standard sizes of street car motors; also commutator rings, and a large assortment of field spools and tubes of all sizes up to 16 inches long. The exhibit was in charge of Manager C. W. Jefferson, and in his hands was very effectively handled.

THE H. W. JOHNS MANUFACTURING COMPANY had a very attractive exhibit on the ground floor of the Exposition Hall. Some very handsome sample boards, together with numerous loose samples, showed to advantage the complete line of trolley insulators sold by this company. Their new "Giant" strain insulator was well illustrated in these sections; 6,500 pounds is the weight at which it is claimed this insulator will break. The company was represented by Mr. W. F. D. Crane, of the electrical department, New York; Mr. H. A. Reeves, of the Chicago office, and Mr. J. W. Perry, of the Philadelphia office. The Johns-Pratt Company, of Hartford, was represented by Mr. E. B. Hatch, who spent most of his time at the exhibit.

ALLIS COMPANY.—In their immense works, this company had the most interesting and instructive exhibit ever brought to the attention of a street railway convention. Not only were the delegates surprised and pleased at their reception by the Allis Company, but they were very glad to receive the neat little folder furnished by the company giving statistics on the engines of this type in "Electric and Cable Railways, and Electric Lighting Service." The list was truly formidable. Mr. W. M. Ruth was indefatigable in his efforts to entertain the visitors, and his services were greatly appreciated. He was ably assisted by his genial side partner, Mr. Rogers, and by Messrs. Gene Tucker, John Allan and Al. Hoppin.

THE PECKHAM MOTOR TRUCK AND WHEEL COMPANY, although greatly disappointed and embarrassed at the failure of their exhibit material to arrive, by clever management, arranged a most creditable display in the centre of the hall. They secured one of the ordinary trucks recently shipped to the Milwaukee Street Railway. This was surrounded by some excellent specimens of palms artistically arranged. On their table was a very attractive aluminium model of their truck. The exhibit in which they took greatest pride, however, was the 22-foot car mounted on one of their trucks which has been running ning for a year without any repairs, whatever. Mr. Edgar Peckham was about the hall in person, and was one of the interesting characters of the convention. With him were associated Mr. A. W. Field and the Western agent, Mr. P. S. Bemis, Jr.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY.—The headquarters of this company were located on the ground floor of the Pfister. Here were displayed to good advantage all types of railway devices. The feature of the display was the new series-multiple controller recently perfected and placed on the market. This apparatus won many compliments. A full line of the unequaled literature supplied by this firm was at the disposal of the visitors. Mr. Lemuel Bannister, the vice-president of the company, was present himself part of the time. Other Westinghouse representatives were Messrs. W. C. Clark, B. F. Stewart, C. E. Bragg, W. S. Brown, Norman McCarthy, G. Pantaleoni, J. A. Rutherford, E. W. T. Gray, F. S. Burrows, W. J. Longmore, W. F. Zimmerman, Maurice Coster, Albert Schmidt, T. Allen, G. H. Sanderson, Geo. E. Fairbanks and E. H. Heinrichs.

THE J. G. BRILL COMPANY, of Philadelphia, had a very complete line of trucks at their in-door exhibit. This included one No. 20 Eureka Maximum Traction Truck, a sample of their well known double truck for use

under eight-wheel cars: one No. 25 truck, and one 21 truck. They also showed some solid forged frames as a specimen of the material from which their trucks are made. The moving exhibit embraced one 22-foot, double track car, one 18-foot car, and their great double-decked car, which was the feature of the car exhibits. This car was run continuously between the hotels and the Exposition building, as well as over various sections of the city lines, and was highly praised. Mr. John A. Brill was himself in charge, ably assited by Mr. "Pay" Andrews, the Chicago agent, and Messrs. F. C. Randall, W. H. Heulings and S. M. Curwen. At Brill headquarters, Pfister House, some of the best things dealt in during the convention were always to be had, and as a consequence the rooms were generally crowded.

The General Electric Company were very happily located at the Pfister. They enjoyed a practical monopoly of the parlor floor, while their exhibit at the Exposition was close to the entrance. This exhibit embraced an 800 General Electric Motor equipment, mounted on a McGuire truck, and kept in operation; one of their S. P. controllers, Form K, with interlocking features, and a full line of overhead material. This company also had in operation on the various lines of the city one of Brill's double-decked cars, equipped with G. E. 800 motors; a double truck car with same equipment; a Lewis & Fowler single truck closed car, and a snow sweeper. Its list of representatives included such well known men as Messrs. O. T. Crosby, W. J. Clark, J. B. Blood, R. H. Beach, Thos. Addison, Thos. P. Bailey, A. K. Baylor, C. K. Stearns, W. H. Knight, Theo. Stebbins, G. K. Wheeler, Ben Willard, C. E. Collins, H. J. Crawley, W. B. Potter and C. Bushnell. Their "Feast of Flowers" the night of the banquet was one of the prettiest scenes ever witnessed at a street railway convention.

Chas. Munson Belting Company.—The belting exhibit made by this enterprising firm was admitted to be one of the most complete and interesting on the floor. It included a full line of their "Eagle" and "Dynamo" belting. A section of the 80-inch belt recently furnished to the Toledo Electric Company was shown. This belt, the largest belt in the world in actual operation, was finished and placed on the pulleys within one week from the date of ordering, taking the place of another make of belt. This remarkable belt is now transmitting the normal horse power required of it, and is capable of doing twice the work if it were required. The exhibit made here calls to mind the exhibit made by the same company in Electricity Building at the World's Fair, where the Munson belts were awarded the medal on "the quality of leather for belting purposes." This leather is tanned by A. Groetzinger & Sons, of Allegheny, Pa., and has been used in Munson belting for the last 20 years. Mr. Wm. Groetzinger was in charge of the Milwaukee exhibit, and received many compliments on both his belting and display.

## Direct Driv n Generators.

BY C. J. FIELD.

*Abstract of paper read at Milwaukee Convention.*

SOME of the European manufacturers, back in ing Brush and Siemens & Ha'ske, commenced to build direct-driven generators of small capacities connected to various types of high the earliest of this class speed engines. Among the earliest of this class of apparatus were Brush machines connected to Westinghouse engines. For use in central stations Mr. Edison designed, perhaps, the first apparatus for the Pearl street station in New York City. These machines were of about 300 h. p. capacity directly connected to an Armington & Sims automatic single cylinder engine operating at about 250 revolutions. These sets are still in use at the present day, except those that were destroyed by fire several years ago, and one was on exhibition at the World's Fair. This type of generator and engine was soon given up and the belt driven generators were again employed. In Europe, however, although the development was slow, it advanced further, and a number of large stations in Berlin, Paris, London and elsewhere were equipped with direct driven engines up to 1,000 h. p., vertical engines being largely used. In 1887–88, perhaps, the development of this type of apparatus by American manufacturers began. It was not until 1890 that the large companies, however, commenced designing and building direct connected generators for railway work.

Different types of direct connected generators may be advantageously then considered, and five illustrations will be given. For the first the Westinghouse generator may be taken, which is coupled direct to a Westinghouse engine by their well known method of flexible clutch coupling. This is a multipolar machine with ironclad slotted armature and is built entirely separate from the engine, the engine and generator having separate shafts. The speed is somewhat higher than those of other manufacturers of the same capacity. The generator is of the same genral appearance as the belted machine, built by this company.

For the second illustration the type of machine built by the Siemens & Halske company is used; this is mounted directly on the shaft of the engine, which shaft is supported at the outer end by an outboard bearing. In this type of machine the electromagnet is placed inside of the Gramme ring, and thus the diameter of the armature is largely increased, making the machine especially adapted to a direct connection. The field magnets are bolted to the pillow block of the main shaft and the ring-shaped armature keyed on outside the magnets to the main shaft like a flywheel and the outer end of this shaft is supported as stated by an outward bearing. This machine is not provided with any especial commutator, armature winding is on solid copper bars, on which the brushes rest.

The third example is that of the two 200-kw. generators directly connected to a 750-h. p. automatic cut-off engine operating at a speed of 120 revolutions. An illustration of these machines was given in The Electrical World of Oct. 21, 1893. This generator is of a type developed by the old Edison company for central station work, and is what is termed a smooth body type of armature; the armature turns consist of solid copper bars U-shaped and slipped over the core or body of the armature, the brushes bearing on the end of the same.

One of the large engines in operation in the Intramural Railway power station at the World's Fair is taken as the fourth type. This was shown in The Electrical World of Oct. 7, 1893, and is an 800-kw. machine manufactured by the General Electric Company, and is what they term their ironclad body type of armature, which is the type they are specially developing for railway power work. This machine is self-supporting in that the armature is not mounted on the engine shaft, but has its own separate shaft, and is coupled to a vertical type of compound marine type of automatic engine, manufactured by the Lake Erie Engineering Works. This unit is next to the largest which has been built for railroad work, and has been in continual service in this power house since the day it started, the 4th of July, and has operated almost wholly the entire service of the electric elevated railroad at the Fair. The engine and generator have stood an overload as high as 80 per cent. above their rated capacity, and seem to be specially adapted to stand severe strains of railway power work. While the generator is not quite so compact in floor space as those which are mounted directly on the engine shaft, it seems to possess in many respects desirable points as regards engine and generator connections for railroad power based on practical experience and its operation on this severe work, and has already resulted in its adoption for several large plants.

The fifth type is what may be termed a Jumbo generator for railroad work and has double the capacity of the last one described. It is also built by the General Electric Company and is of the same general type as the last machine. Six of these units are being put in operation in the power station of the Brooklyn City Railroad, and the one here referred to is in the power house of the Intramural Railway, at the World's Fair. It is run by a cross compound Reynolds-Corliss engine, and is shown in The Electrical World of May 6, 1893. On account of the general construction arrangement of the engine the generator is shown mounted directly on the engine and alongside of the flywheel. The field magnets on both this generator and the 800-kw. machine are so arranged that by turning a crank the magnet frame can be moved to one side, leaving the armature entirely accessible for removal or repair. This generator has not as yet been extensively operated in regular service, but has been used sufficiently to demonstrate that it is a well designed machine and has shown its ability to carry the same proportion of overload as the 800-kw. machine.

These examples show that the design of this class of apparatus has reached a practical commercial development.

The type of engine to be used with direct-driven generators is a question that deserves serious consideration. The vertical engine is preferable if a compact plant is desired. The size of the generator in use at the present day seems to throw out high speed engines as the limit of their economy appears to be about 200 h. p. to 300 h. p., that is, where controlled by a single valve. There remains then two types of engines, the Corliss and a modified vertical marine type. An engine of the latter class, well and substantially built with double valves on the steam and exhaust, and controlled by shaft governor, controlling the valve up to three-quarters cut-off, would seem to combine many points of superiority of an engine on this class of work, and give service in reliability, economy and durability superior to any other type obtainable. Manufacture rs and designers in this country are now rapidly developing this type of engine, and they are being built by such manufacturers as the Lake Erie Engineering Works, Dickson Manufacturing Company. McIntosh & Seymour, Porter Allen and others. The relative advantages, cost and economy, must also be considered. In general, direct generators are sold for about 20 per cent. above the cost of belt-driven machines of the same capacity, but for large units this difference will be considerably reduced. On account of the economy of space and for other reasons, the writer has found that the cost of a power station complete, exclusive of real estate, but including the same electric plant and building, is not more in a direct-driven plant than for one of the old type. This should settle the question beyond doubt, especially where a new station is being built. The economy will be large in every respect, and satisfactory operation and reliability will be the results obtained. A direct and positive saving of weight from 10 to 50 per cent. can undoubtedly be obtained, as shown by results from actual practice. A specific case may be quoted in which a company having a power plant of about 5,000 h. p. have become convinced that they could build a new one, increase their fixed charges thereby $15,000 per year, and still have a net gain over their net charges of $25,000 per annum, in addition to a more reliable and better operating plant and increased capacity.

## Power House Engines

*Abstract of paper read at Milwaukee Convention.*

THE American Street Railway Association at its 1892 convention appointed a committee consisting of E. G. Connette, L. H. McIntire and F. S. Pearson to prepare a report on power house engines, which was presented at the Milwaukee meeting by the chairman. The subect is considered under the heads of regulation, economy, durability and division into units, which arrangement is followed in the following abstract:

An engine that will regulate within two per cent. is practically perfect for street railway work, though there are engines on the market which on electric railway service can be held to one per cent. deviation from the mean speed. The governor should be easy of access to all its parts, capable of being oiled while the engine is running, and particular attention should be given to its construction so that there may be no weak points; it should not be intricate or complicated, and the range of cut-off should be much larger than engines for less variable load, and be easily regulated between the limits of one-tenth and seven-tenths of the stroke.

Attention is directed to the importance of having the best possible construction and material in the engine, with extra weight in the flywheel and bedplate, and more than usually substantial foundations. One of the most important features to be observed in order to maintain perfect regulation is to place the engine in the hands of a competent engineer who is capable of adjusting it and keeping it in good running order.

In order to obtain the highest economy in the operation of an engine it is necessary to have it properly adjusted to its load. Underloading or overloading are both uneconomical, though large compound condensing engines will stand underloading better than a simple high speed engine, and all classes will stand underloading better than overloading. There should be ample power both in boilers and engines to obviate excessive overloading, as well as to provide for contingent breakdowns and needed repairs.

Attention is called to the necessity of keeping machinery in the best possible working condition; the packing should be kept intact, valves free from leaks, cylinders perfectly smooth and true; the cylinders and bearings should be kept well lubricated and a steady steam pressure maintained; careful attention should be paid to the setting of the valves, and the engines should be placed in close proximity to the boiler so as to require the least amount of steam pipe, which should be covered with one of the best non-conducting materials. Flexible joints should be used in pipes to prevent leaks from expansion and contraction.

Reference is made to the recent tests on the steam turbine, and it is pointed out that its simpliciy of construction and consequent low cost and very high efficiency as a motor all tend to make it a strong rival to the ordinary steam engine for electric light and power stations.

The boiler plant should have ample capacity, as there are few cases where the draft or setting will allow heavy forcing without a serious loss of economy. The raising of evaporation from six and one-half to seven pounds of water per pound of coal represents a saving of about seven per cent. in coal, which would warrant an expense for improvements to attain this equal to one whole year's coal bill. Boilers should be equipped with good boiler cleaners, inspected regularly and kept free from scale; the flues should be kept clean, and to obtain the best results the boiler-room must be in charge of a competent man. This last point is dwelt upon, and a plan recommended to encourage economy on the part of the fireman by paying him a coal premium at the end of each month, basing the amount of the premium on the average number of bushels of coal consumed each day during the month for a certain number of cars run. The writer of the report, Mr. E. G. Connette, states that this plan was adopted by him about two years ago with very satisfactory results. The limit on the average number of bushels per day to secure the premium was placed at a point that required economy and skill on the part of the fireman to keep within the limit, and during the past two years they have succeeded in obtaining the premium

about one-half of the time. The report adds that careful firing is a good smoke preventative, preserves the boiler and saves coal, gives a steady steam pressure, secures an economical point of cut-off, and consequent economy through expansion of the steam. When the plant is of such size as to require more than two firemen it is always good economy to employ mechanical stokers, not only from the saving of labor, but through economy in fuel, uniformity of steaming and prevention of smoke; chilling and straining the crown sheets by inrushes of cold air are also thus prevented.

As to the use of oil for fuel, the result of the recent and extensive tests at the power plant of the Twin City Rapid Transit Company, of Minneapolis, Minn., is given, showing that ordinary Lima oil, weighing 6.3 pounds per gallon and costing two and a quarter cents per gallon, was equally economical with coal at $3.85 per ton giving an evaporation of 7½ pounds of water per pound of coal. For the same coal at $2 per ton the oil was 30 per cent. more expensive, and with coal at $4.85 the coal was 20 per cent. more expensive. These results included the difference in the cost of handling the coal, ashes and oil. The evaporation of the latter was 20.63 pounds of water from and at 212 degrees Fah. per pound of oil.

Attention is called to the necessity of furnishing the station engineer with full facilities for testing and maintaining records of each part of the station plant in operation, in order that comparisons may be made with other plants to determine if there is any falling off in the plant itself and to suggest where improvements may be made. With modern appliances and fairly well constructed plants a total station efficiency of 70 per cent. should be set as the standard.

A considerable waste of power in friction of belts, etc., and the expense of maintaining the various arrangements for the transmission of power by belts may be avoided by connecting the generator direct to the shaft of the engine.

While machinery of this class is more expensive than the other, the saving in power and maintenance of the machinery of the transmission will be sufficient to compensate for this and warrants the recommendation of direct-driven equipments for moderate or large-sized plants. Besides, another important advantage is the considerable saving in floor space.

The committee looks with favor upon compound engines for street railway work, especially so with engines having ranges of cut-off wide enough to keep the pressure in the low pressure cylinders from descending below the atmosphere. Where it is possible to condense in connection with compound engines there is not the slightest question as to economy, and with condensation there is no reason why the expansion should not be caried to a further limit.

The use of a light overhead traveling crane is recommended with differential pulley blocks for handling armatures, cylinder heads and other parts of machinery. The committee reports against the practice of placing the generators in the second story of the power-house, even where floor space is difficult to secure, and the plan adopted by the West End Company, of Boston, of placing the countershaft into a basement pit, thus keeping generators and engines on the same floor, is spoken of as worthy, of consideration with extraordinarily large plants by securing rigidity of foundation, necessary belt lengths and economy of floor space without going to direct connecting of generators to engines. In regard to durability, it is stated that the former lack of this quality is being overcome by making all parts of machinery more durable and introducing improvements to meet the demand for the extraordinary class of work called for in street railway practice.

The following table is given as showing approximately the proper division of engines in plants of different size:

| Maximum h. p. required operate road. | Number of engines required. | H. p. of each engine. |
|---|---|---|
| 200 | 2 | 200 |
| 400 | 3 | 200 |
| 600 | 3 | 300 |
| 1,000 | 3 | 500 |
| 1,500 | 4 | 500 |
| 2,000 | 4 | 750 |

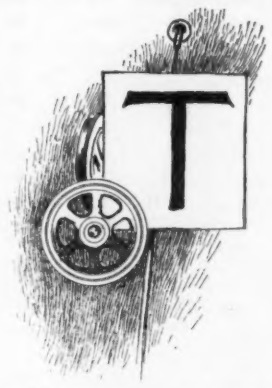
As will be seen from the table, there are always enough engines o furnish the maximum horse power and have a surplus of one engine to take the place of a disabled one and to enable the engineer to adjust and repair the various engines in their turn. The maximum horse power referred to in the table is not to be taken as the sum of the power needed by each car in service except in small installations; the maximum power does not increase in proportion to the number or cars in use, because as this number increases the fluctuations of load tend to balance and to render the maximum load nearer the average load. Thus, in a 10-car plant cases will occasionally occur when all the cars will require the full power at the same time, but there is no probability of this in a 100- car plant, where from 60 to 75 per cent. of this maximum power will be sufficient.

The committee concludes that in selecting a type of engine the size of the installation must largely govern as well as local conditions, such as water supply and price of fuel, hough some consideration may have to be given to questions of station room and arrangement. For small plants to run 10 or 15 cars, simple high speed engines belted direct to generators are unquestionably the proper choice. For 20 to 50 car plants, compound engines, with condensing apparatus where it is possible; with tandem compound engines for the smaller plants and cross-compound engines for the larger ones, geared direct to generator, will probably be found most economical. While for the larger systems compound or triple expansion condensing engines, using steam at a high initial pressure and either driving a countershaft or coupled direct to generator, whichever the conditions of the case will warrant, will be found a proper selection. In every case, except for small plants, where engines are belted direct to generator, the vertical type of engine is recommended. The committee dwells on the importance of keeping the steam plant as near as possible to the conditions that exist when the engines are installed, and under the supervision of the mechanical engineer who installed the plant. This, perhaps, is of as much or more economic importance than the design of the engine, as the plant is then run by the expert in charge with a view to attain the highest degree of efficiency and economy.

## Traction and Street Railway Trucks.

BY ELMER H. SPERRY.

*Abstract of paper read at Milwaukee Convention.*



TO the popular mind the laws governing traction or adhesion are entirely divorced from those governing friction. This view is not correct. The adhesion between the wheel and rail is really friction of quiescence. In studying the laws governing both friction of quiescence and friction of motion one is struck with a peculiarity in the curves; notably so when metallic substances are undergoing examination. The characteristic relates especially to a remarkable drop constituting practically a vertical line between the readings taken before and after slipping commences between the metallic substances under test. The curve shown in Fig. 1 is taken as between a rail and wheel supporting about 3,200 pounds.

The writer is of the opinion that what is known as friction of quiescence or adhesion between a wheel and a rail consists essentially of molecular gearing, the teeth of which, though minute, are as positively in mesh as those of the regularly organized gear. Whether they be in fact the molecules of the chemist is a question, but they are certainly the interlocking of the minute irregularities of the substances. These have been found to be maximum when the substances are alike, under these conditions the aforenamed molecules or irregularities probably being very similar as to dimensions. By this statement it is not meant that the highest values are necessarily attained under conditions of like materials, but that the lines connecting the higher and lower values are more nearly vertical, arguing more complete intermeshing, hence in shearing a more sudden giving away of the molecular teeth at the time of dropping from the high to the lower values or co-efficients. The curve in question is drawn to scale, and graphically portrays the extremely low values in terms of traction or drawbar pull, upon the dynamometer of the slipping wheel, as compared with the wheel rolling upon the track without slip. This curve was obtained in determining by trial the grade at which forwardly revolving slipping wheels would just balance the tendency of the weighted car

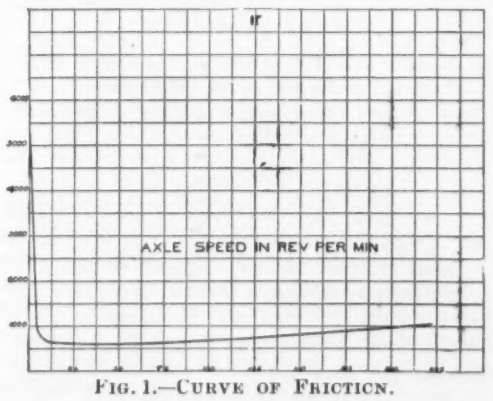



FIG. 1.—CURVE OF FRICTION.

to slide down the grade. The curve shows the instant of starting to slip to be the critical point, and the problem is pre-eminently one of preventing the wheels in question from starting to slip.

The oldest method of accomplishing this purpose has been to couple all the drivers for absolute harmony and uniformity of movement, so that the tendency to slip of one driver will be held back by all the others instead of by its mate only. Experiments have been made to determine whether it is found in practice that the coupling of the wheel in any way increases the traction, including a bi-axled equipment of the ordinary kind with an independent motor for each axle, and also equipment consisting of four, six and as high as eight separate drivers locked together and compelled to revolve in unison, being supplied with a single motor or source of power. The writer found the method employed in coupling the wheels to seriously affect the traction appearing as drawbar pull. For instance, if locomotive connecting rods are used, the necessary flexibility of truck as to parallelism of axles must be either entirely sacrificed, or if allowed to exist it produces a continually and constantly recurring tendency to slip resulting in a change from compression to extension of all the strains in both the truck and connecting rods. This change occurs twice in each revolution of the system, and results in a slip alternately of the wheels upon each side in amount dependent upon the lost motion existing. In some experiments this periodic slip amounted to as much as five-sixteenths of an inch, occurring twice each revolution, when working upon a grade without a trailer attached.

This is avoided by steam locomotive engineers by holding the axles in absolute parallelism in plane normal to the roadbed. As to the street car truck, the flexibility necessary argues the employment of belting or rope transmission. The strains, however, which motor gearing is called upon to stand are tremendous, and no form of friction drive or friction gearing is admissible. The chain drive was first employed, but was early abandoned on account of noise, excessive wear, journal strains and impossibility of keeping it lubricated. The bevel gear seems to present the simplest solution, but has been looked upon as inefficient. The writer designed an apparatus to test the comparative efficiency of beveled gear and pinion and spur gear and pinion, shown diagramatically in Fig. 2. B is a car axle mounted in journals, D D. E is a hydraulic dynamometer, with lever arm, E, and weight, F. A is an electric motor delivering its power to a

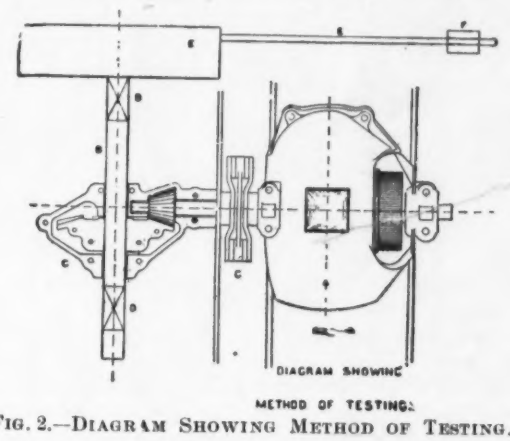



FIG. 2.—DIAGRAM SHOWING METHOD OF TESTING.

pinion co-operating with a gear mounted upon the car axle, B, C being a flexible connection as between the motor and the pinion shaft. The car axle was three and three-eighths inches in diameter, and two sets of gearing were employed as between the axle and the motor: First, the bevel gear and pinion (shown in the diagram) inclosed in an oil housing, G, which were alternated with the test of spur gear and pinion also mounted within an oil housing, when the spur gear was used, the motor being set around at right angles to its position as shown in the diagram, and parallel with the axle, B, and connected with the shaft of the spur pinion. The spur gears were four and a half inches face, cut in steel, finished on an Eberhardt machine with Brown & Sharp cutters, running in an oil-tight casing in which three-quarters of a gallon of oil was placed. They were accurately placed on pitch line, and running very easily and smoothly. The bevel gears used were turned out by the Walker Manufacturing Company, the test in question being used to ascertain the best shape of teeth for the work. The bevel gear was five and a quarter inches face, the teeth were uncut, and of coarse pitch cast very smooth and double shrouded, the pinion being cast steel, uncut, and five inches face. It will readily be seen that the conditions under which these tests were made were as nearly alike as it was possible to make them, and at the same time the transmissions were worked under the same conditions that obtain when mounted on a street car truck. From numerous curves which were obtained under practical working conditions, it would appear that when the bevel gear is properly made the losses are almost identical with spur gear; the small difference, 1.74, perceived in favor of the cut gear is probably due to the fact that the surfaces were somewhat rougher in the cast gear. Another important feature is that of axially mounted masses, and it should be recognized that the wear and tear of roadbed is due in a large measure to the heavy masses attached directly to the axle, and it is immaterial whether the axle is compelled to carry much or little of the weight of the mass so long as such mass is rigidly attached thereto, inasmuch as the axle is compelled to follow the laws of falling bodies controlled by the weight and inertia of the mass as a whole. All weights of magnitude should spring supported.

Referring now to the tests, a grade was built consisting of 45-pound T rails rising from a spur of level track, giving a mean grade of the two rails of 12.4 per cent. Upon this grade was run, first, a double

motor equipment weighing 17,935 pounds. A dynamometer was attached to the drawbar and back to the track in such a line as not to either lift the car or drag the rear end downward in the test. Current was then applied through a variable resistance, gradually allowing the car to strain upon the dynamometer until finally the wheels slipped. Care was especially exercised on the point of gradual application of the strain so as to eliminate all elements of inertia or lunging forward upon the dynamometer; after slipping had commenced it was observed that the car would slide in each instance to the bottom of the grade. The following table gives the mean of four sets of readings:

INDEPENDENT AXLE, TWO MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing on 12.41 per cent grade. Weight of equipment, 17,935 pounds.

| Group of tests. | Average amperes. | Average drawbar pull. | Ratio drawbar pull to weight. |
|---|---|---|---|
| 1 | 1,625 | 200 lbs. | 9 per cent. |
| 2 | 2,2 0 | 280 " | 12.5 " |
| 3 | 2 150 | 240 " | 12 " |
| 4 | 2, 75 | 230 " | 11 " |

This car was run off the grade and replaced with one in which all the wheels were compelled to revolve in unison, but of much lighter weight, viz.: 12,685 pounds. The dynamometer was attached in the same way and the same rheostat and source of current was used as in the previous experiment, the axles in this equipment being coupled by the bevel gears shown and described in connection with the gear tests above referred to. The following table gives the mean of five sets of readings taken from this car:

COUPLED AXLES, SINGLE MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing upon 12.44 per cent. grade. Weight of equipment, 12,685 pounds.

| Group of tests. | Average amperes. | Average drawbar pull. | Ratio drawbar pull to weight. |
|---|---|---|---|
| 1 | 260 | 3,125 lbs. | 24 per cent. |
| 2 | 240 | 3,750 " | 30 " |
| 3 | 2.0 | 4,075 " | 32 " |
| 4 | 220 | 4,500 " | 35 " |
| 5 | 206 | 4,375 " | 34.4 " |

The same operator applied current to the car in both tests, and every condition of electrical pressure, track and water, remained identical throughout. The accompanying photograph shows the car standing on the grade with dynamometer attached.

The car was then run off the track and the rails blocked, the rail on one side being 12⅔ inches rise in 10 feet, the other being 17.2 inches, making a mean of 14.92 inches rise in 10 feet, equalling a grade of 12.44 per cent., giving a warp of considerable magnitude to the roadbed. This would at once develop any rigidity introduced into the truck by the coupling, and show up materially in the ratio of drawbar pull to the current absorbed if the equipment or any part was bound, unduly strained, or working under any but perfectly normal conditions. The following table shows the readings taken, and is conclusive as to the perfect freedom of the truck while working in this warped and highly distorted position.

COUPLED AXLES, SINGLE MOTOR EQUIPMENT.

Drawbar pull on dynamometer. Car standing upon warped track:
Right rail..... 14.33 per cent. grade.
Left rail..... 10.58 " "
Weight of equipment, 12,685 pounds.

| Group of tests. | Average amperes. | Average drawbar pull. |
|---|---|---|
| 1 | 230 | 4,425 lbs. |
| 2 | 220 | 4,375 " |
| 3 | 200 | 4,150 " |
| 4 | 220 | 4,275 " |

It will be readily understood that when an equipment is working upon a grade, the centre of gravity of the car falls more nearly over the rear wheels, allowing the front pair to slip when independently driven. After slipping commences the tractive value of the front motor becomes almost nil, as shown by the traction curve in Fig. 1, the work being undertaken almost entirely by the rear motor. Whereas with coupled drivers, and especially where a single large capacity motor is used, the additional weight upon the rear wheels gives additional tractive power to these wheels, and the motor is compelled to deliver all its power to this pair if the exigency requires. At the same time the front wheels, instead of slipping, are compelled to revolve in step with the back wheels and bite the rail in unison therewith, and in fact all the wheels are held down to the business of effective non-slipping adhesion, this being true in whichever way the car approaches the hill, and whichever pair of wheels are respectively forward and rear. This great difference in favor of coupled drivers shows a percentage of 35 as compared with 12.5 of the total weight appearing as actual pull at the drawbar under the conditions named. While working upon a level, and especially in damp weather with a slimy rail, almost the same advantage in traction will be found to exist as is here given for coupled wheels, provided always the mechanism used in coupling does not interfere in the least with the flexibility of the truck.

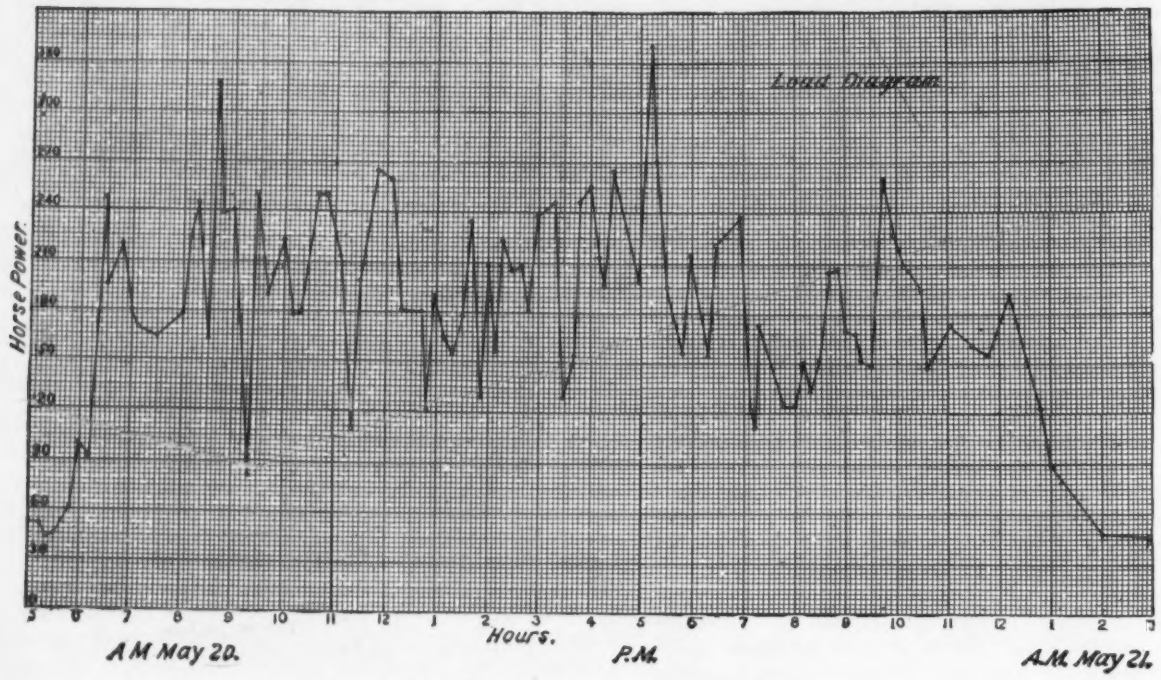



FIG. 1.—STREET RAILWAY LOAD DIAGRAM.

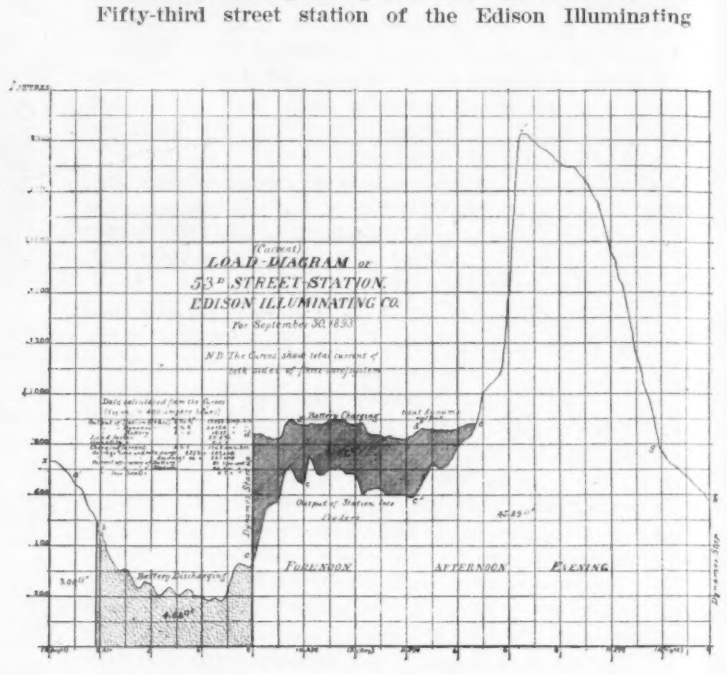
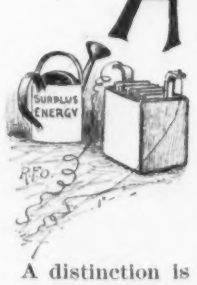



FIG. 2.—CENTRAL LIGHTING STATION LOAD DIAGRAM.

## The Use of Storage Batteries in Electric Generating Stations for Electric Lighting and Regulating Power.

*Abstract of paper read at Milwaukee Convention.*




A REPORT on the use of storage batteries for utilizing and regulating the power of generating stations was presented by Mr. C. O. Mailloux at the Milwaukee meeting of the American Street Railway Association, in which the subject is treated in a very comprehensive manner and the details of a number of storage battery plants in central stations described.

A distinction is made between variations and fluctuations of load, the former term being used to designate the effect caused on a power plant by putting on or taking off a certain number of cars, and the latter to designate those incessant and erratic changes of current due to stopping and starting of cars, changes of grade, speed, etc. The variations of load are defined as changes in the mean or average rate of production for a given period of time, and fluctuations as changes in the rate of production from one instant to another. The distinction between the two will be more readily understood from the diagrams, Figs. 1 and 2. The first shows a street railway load diagram reproduced from a paper on "Electric Railroad Construction and Operation," by C. J. Field, and the other the load diagram of an incandescent lighting station. Taking the latter it is seen that the momentary fluctuations are trivial in comparison with the variations of load from hour to hour and from one part of the day to another. In the railway plant diagram (Fig. 1) the series of ups and downs following each other are more or less irregular throughout the whole day; in this case, where the number of cars was not less than 15, the load ranged at different times between 80 h. p., or about 50 per cent. below, to 380 h. p., or over 100 per cent .above the mean load, which is about 170 h. p.

These fluctuations cost money in three different ways; first, because they involve the use of generating machinery of greater capacity than would be required of the machinery operated at a constant uniform load; second, because of depreciation; and, third, because the efficiency of the machinery is lower, on account of the increase in the percentage of energy spent in the large engine and dynamo to overcome friction and to supply the magnetizing energy. Experiments have shown that this is a paint of the utmost importance in considering economy of operation, and seriously affects the use and consequent benefit of multiple expansion engines. As to the steam factor alone, cases are not rare where the use of engines too large, but rendered necessary on account of fluctuations in load, have consumed from 10 to 15 per cent. more steam than they would at a normal constant load. Considering the dynamo and engine losses referred to, the net efficiency will be the product of these two factors; if the steam consumption is, say, 20 per cent. greater than it would be per average indicated horse power, and if the engine and dynamo utilized 15 per cent. less than the indicated power that they would if of more considerable size, the net efficiency will be the product of these two factors, or in this case only about seven-tenths of the steam will be utilized.

A brief reference is made to a number of electric lighting stations, in which the storage battery has been used for regulating the load. In the New York Fifty-third street station of the Edison Illuminating Company there are 140 Compton-Howell cells, each of about 1,000 ampere hours capacity, weighing some 750 pounds, and of about 40 inches in height, 21 inches in depth and 15 inches in depth. The battery has a normal discharge rate of about 200 amperes, but can be discharged, if necessary, at 500 amperes. The curve of Fig. 2 gives a station record, and shows that the current is delivered continuously at varying rates. The station now runs from 8 a. m. one day to about 2 a. m. next day, or about 18 hours. When it starts at 8 a. m. it carries a two-fold load; first, the regular load allotted to the station, shown by curve *c c c'' e*; second, the load represented by the curve *d d d'' e*, which is the current absorbed by the batteries in charging. It is to be noted that the total load is much more uniform than if the station were feeding into the mains alone, for the extremes of current fluctuations shown by the curve represent a total variation of only 80 amperes on an average load of 850 or less than 9½ per cent. More recently the storage battery has been made to play an additional part on account of the maximum load having increased so that the station plant is no longer adequate; the battery is now put on to supply the excess of current required above the capacity of the dynamos. When the load begins to fall off about midnight a part of the plant is shut down, but since the load is still too heavy for the other dynamos the batteries again serve to supply the excess (from *g* to *h* on the curve).

There is only one other case in this country, namely, the Edison station at Germantown, Pa., where storage batteries are used as load regulators. In this case the battery saves expense of running the plant during the period of small load, and additional capacity is contemplated by the company. A large battery of Tudor cells is being installed at the central Edison station in Boston, the cells being over twice the size and capacity of those of the Forty-third street New York station referred to above. The New York Edison station has also in contemplation the use of a similar battery.

It is in Europe, however, that the use of storage batteries in central stations has made the most headway. In the city of London there are no less than eight stations supplying current for lighting in which storage batteries are depended upon for part or the whole of the load carried. In many cases the batteries are not placed in the generating station, but in sub-stations located with reference to the consumers. The charging current is sent to the batteries at high potential, several sub-stations being joined in series for

the purpose of charging. In Paris there are some 20 or 30 such sub-stations located in various parts of the city, and all charged from the same central station. In one instance a 2,800-ampere hour battery is located at a point at a distance from the central station and charged from the mains at those hours when the load is light, the potential being regulated by means of a continuous current transformer. This energy is given back to the line during the busy hours, thus saving the cost of large feeders and also furnishing a load for the hours of small station load. This plan may be of possible service in railways covering a large area, various sub-stations being fed from a single central station. The batteries could be located at distant points, or at such points as to give the best distribution to the trolley lines with the least expensive line work. The station machinery would then furnish current at constant load to feed the batteries which later would supply the power required for the car motors. In this way not only would there be an economy in the case of conductors, but greater uniformity of potential over the entire system.

Reference is made to a number of other storage battery stations in Europe, and then the subject of the types of batteries used is taken up. It is pointed out that the Plante process of formation of batteries and its modifications seem to have proved superior to the pasting or Faure process, as at least nine-tenths of the aggregate of the central station batteries used are of the Plante type or of some modification thereof. There is probably no storage battery on the market of

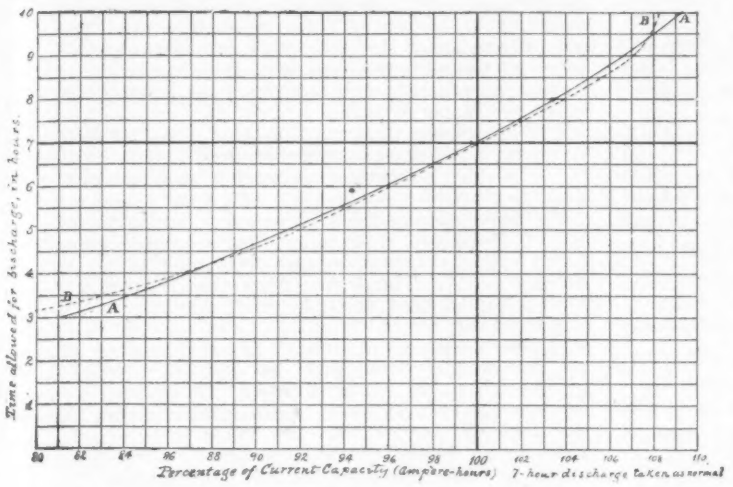



FIG. 3.—BATTERY DISCHARGE EFFICIENCY CURVE.

American manufacture having as great a capacity as 500 ampere hours, while in Europe there can be procured batteries up to 5,000 ampere hours capacity. A cell of the latter capacity weighs complete some 4,750 pounds, and its dimensions are 36 by 39 by 40 inches high. A good idea of the scale of operation is obtained by examining the plans of central stations, such as that at Hanover, where a separate building, with four floors about 70 by 35 feet, is reserved for the storage batteries.

Attention is called to the fact that the capacity of a battery is lower when the discharge rate is increased. In Fig. 3 the two curves from different sources show how the capacity varies with the time allowed for the discharge, the capacity of a seven-hour discharge being considered normal and taken at 100 per cent. It will be seen that the efficiency becomes lower at the greater rate of discharge and greater at the smaller rate. Efficiency should not be confounded with capacity, as it involves loss in voltage as well as of current quantity, and it is well known that voltage is reduced as the rate of discharge decreases. However, as the variation in voltage is slight in comparison with that in ampere hours, the efficiency percentage curves would resemble and approximate closely to those of Fig. 3. Efficiency data from several stations are given showing that it ranges from 78 to 85 per cent., and it is stated that all authorities consider an efficiency of 75 per cent. can be expected and under conditions may reach 80 per cent. or more. Some figures as to cost of batteries are given showing that this decreases relatively with the size of the battery.

The maintenance of batteries is generally guaranteed by the manufacturer, the usual rate being about five per cent. per annum on a 10-year guarantee. In some instances in Europe the lighting companies found they could themselves undertake the maintenance and effect a saving, and in some of these cases it has been as low as four per cent. for a period of several years. It is understood that the battery at the New York Edison station has been installed under a 10-year guarantee of 3.5 per cent. per year. It would appear, however, from a consideration of the conditions involved in street railway use that the depreciation would necessarily be greater, and that not less than 12½ or 15 per cent. should be taken provisionally as the assumed cost of battery maintenance in railway power stations.

The committee reports that in every case investigated it was noted that scrupulous attention was given to details large and small, in the installation of batteries and in their subsequent care and treatment, and the conclusion seems warranted that storage batteries require this attention, not necessarily extensive or expensive, but systematically regulated.

The gain in the use of storage batteries may consist in saving of initial cost of labor or power or may take the form of increased revenue in places where the load comes on rapidly at certain hours, reaches a very high value for a short time, and again quickly drops to a low point, as shown in Fig. 2. It often turns out to be cheaper to use a smaller generator capacity and introduce a storage battery for the double purpose of giving a load to the dynamos when the demand is light, thus keeping the machinery at its highest efficiency, and, second, of supplementing the machinery when the load begins to rise above its capacity. In the case of lighting stations using underground conductors the saving of initial cost sometimes becomes a very important consideration, as a much smaller feeder will answer the purpose, and incidentally the battery serves just as before to give a load at the station during the hours of light load, and, besides, equalizes the pressure in the mains; at the Kensington Court sub-station in London the plant is shut down, the station locked up and the load taken care of entirely by the storage battery for six hours. In the case of water power or gas engines the storage battery enables the power of the whole 24 hours to be prepared so as to be ready for delivery during the short period of full load.

The abundant evidence found for the usefulness of storage batteries in central stations makes it natural to presume that they can also render good service in electric railway power stations. The conditions which the storage battery must meet, however, are scarcely the same and vary considerably in different cases, especially with the size of the plant. The factors involved in the initial cost of a battery are the total maximum quantity of energy that the battery will ever be called upon to deliver, and on the maximum rate at which energy will be put in or drawn out; these may be designated as the battery factors and called the battery watt hour and rate factors respectively. Thus the watt hour factor is defined as the ratio of the quantity of energy to be drawn from the battery to the total watt hours to be furnished the trolley circuits under maximum conditions, while the watt factor is defined as the ratio of the amperes to be furnished by the battery to the total amperes, also under maximum conditions. Other factors to be considered are the station or load factor or the relative proportion of the actual output to the possible output for any capacity of the station. If we take 220 h. p. as the total capacity of a station of which the mean load is 1,168 h. p., the load factor is 53.2 per cent., which means that the plant has only 53.2 per cent. of the earning power it ought to have for its size and for the interest and depreciation which has to be paid for it per annum, and the smaller the power station the smaller this load factor, and consequently the larger the proportion of idle capital invested. Another important feature of this situation is the loss of economy in running machinery at lower capacity. In an instance given there was a steam consumption of 21.5 pounds per hour with engines that would easily do the same work with 16½ pounds at a uniform rate. Or, in this specific case, there is a loss of 5.3 pounds of coal per ton per day.

A larger battery must be used in power stations than in central lighting stations on account of having to be charged or discharged at a higher rate. Taking the ampere hour rate for seven hours' discharge as normal, it is the opinion of the committee that this rate could be safely doubled for short periods, but a rate corresponding to a four-hour discharge may be taken. If the rate of delivery is given in kilowatts the battery capacity in kilowatt hours must be four times that number; or giving the capacity the highest allowable rate, will be one-fourth that number.

The entire question is illustrated by taking a specific case and calculating the various factors and quantities involved. In this case, the cars running after the plant stops or during the night and those running before the plant starts, would draw their current from the storage battery. When the plant starts at 5 a. m., it would deliver some 500 h. p. into the batteries, the rest being sent out direct on the lines; by 6 a. m. the lines would absorb about the whole 800 h. p., and consequently the generating output would be raised to 1,300 h. p., which point the load soon reaches, so that by 6:30 the battery has not only stopped charging, but has even discharged for several minutes at times to take care of the excess of load above 1,300 h. p. From that time until 5:30 p. m. the battery ebbs and flows, the two about balancing. About this time the battery will begin to discharge, and by 6 p. m. will be carrying a 450 h. p. load, being the excess of the total load above the engine load. At 9 p. m. the load falls under 1,300 h. p., and the battery begins to receive the charging current again. From 10 to 12 p. m., the output being reduced to about 800 h. p., the batteries will charge and discharge in turn, but mostly charging.

The capacity of the battery required is calculated at 1,275 kilowatt hours, and taking the cost purposely at a high figure the price of the battery would be $8,450; the depreciation at 15 per cent. and interest at 6 per cent. will make the annual cost $1,775, or $4.86 per day. Assuming in this case a net saving of coal of 4.47 tons at $1.10 per ton, the project would not pay, but at $2 per ton it would effect a saving of $2.08 a day. In a new station, however, the saving would be greater, as the conditions would be so adjusted as to require a smaller generating plant than the one quoted.

The smaller the station the more perceptible the effect of the efficiency; the quantity factor becomes smaller, but the rate factor is usually larger, until on small roads of 10 cars or less it may amount to 60 per cent.

It is pointed out that the storage battery is destined to important applications where water power is used for railway power generation.

The difference between the discharge and charging E. M. F. of a battery may be overcome by introducing into the battery circuit a variable source of potential such as produced by a small dynamo, to which the name "booster" has been given.

As the batteries may just as well, as far as their action is concerned, be located in sub-stations, this would insure a greater uniformity of potential over the whole system, and a saving in copper, against which, however, must be offset the extra expense and attendance of such sub-stations. They may be warranted for this reason only in very large systems covering large and relatively distant territory, and also for interurban lines.

The committee finally sums up its investigations and studies as follows:

1. Great progress has been made in Europe during the last two or three years in the manufacture and perfection of storage batteries suited for central station purposes.

2. Storage batteries have been introduced in a large number of electric lighting central stations on a large commercial working scale, as factors of reserve and regulation, with a view to securing economy of initial cost and cost of operation, with satisfactory financial results as a general rule, which has few, if any, exceptions, so far as your committee could ascertain.

3. The benefits derived in lighting central stations from the judicious use of storage batteries are so valuable in individual cases that the possibility of attaining like benefits, even in lower degree, in railway power stations would justify the investigation of their use by actual experiment where this can be done under favorable conditions.

4. While the conditions differ, and are essentially more severe, in railway power stations, there is no reason apparent why storage batteries may not be used successfully and advantageously for the purpose of securing greater uniformity of potential at the station or on the line, or of promoting and improving the efficiency of the plant.

5. Even assuming the highest values for initial cost and depreciation of the storage batteries, the indications point to the possibility of realizing a gain in economy in all stations operating 200 cars and less, when coal is worth $2 per ton and over, while the economy will be much greater should the initial cost and depreciation prove actually lower in practice. Advantages are also secured which, though not affecting the economy directly, do so indirectly by affording additional convenience in operation.

6. The indications are that in some cases a power plant could be built and operated at less cost by using storage batteries than without.

7. The capacity of an existing plant can probably in most cases be increased more cheaply by adding storage batteries than by adding more generating machinery; while at the same time the cost of operation will be reduced.

8. The question whether storage batteries are expedient and practicable, and to what extent, for any particular case, should be, and can only be, in the present state of our knowledge determined for each case individually by a careful analysis of all the facts and conditions involved by a competent engineer.

9. Practical experience in a certain number of stations alone can lead to definite rules or indications in regard to the best size of battery, the best methods of regulation, the most favorable conditions of use, and like questions.

10. Perfection in the details of the use of storage batteries in railway plants will be the result of a certain evolution, or series of improvements, the same as in other details of the equipment of a plant.

## Aeronautics.

"The American Engineer and Railroad Journal" will publish in monthly parts the proceedings of the recent International Conference on Aerial Navigation, each issue to have not less than eight pages. The title of the new publication is "Aeronautics," and the first number contains in its 16 pages, besides several Congress papers, a contributed article and several abstracts from other sources.

### Underground Conduit Road at Washington, D. C.

*Abstract of Discussion at Milwaukee Convention.*

MUCH interest having been manifested in the Washington, D. C., street railway conduit system at the Milwaukee Convention, Mr. M. D. Law, who had charge of its construction, was asked during the meeting by the president to describe it. He explained that the Love underground conduit consists of an iron yoke, weighing about 300 pounds, with an opening 14 inches wide by 20 inches deep. This yoke has square ends to support the rail, and is embedded in concrete so that the entire track construction is extremely solid and rigid Again, the shallow depth of this yoke obviates the necessity of removing gas and water pipes, which increases the cost of construction in cable railway work to a great extent. In other words, we just climb over the top, and still have a large enough conduit which, by a simple method of sweeping, can be kept clear of all refuse and snow. The slot rail that is attached to this yoke is made of steel, and is U-shaped, having a side bearing of an inch and a half, and projecting into the conduit five inches on the inner side. The insulator is attached to the yoke upon shouldered bolts, and the insulator is allowed to move about two and a half inches laterally, to allow for expansion and contraction. Any expansion or contraction in the rail will not affect the insulator. That is placed under the slot rail, allowing a quarter of an inch of air space. There is a constant draught around the insulator, which prevents any collection of moisture. In the stormiest weather you can take off the slot rail and find a dusty insulator. The slot rail is so attached to the yoke that by removing the bolts in the yoke we can remove the slot rail and get ready access thereto for any repairs that may be necessary. It takes about 15 minutes to remove one 32-ft. length of the slot rail. The trolley wire is suspended on this insulator at a point about even with the lower edge of the slot rail, and about two inches from it, so that it is entirely out of sight and out of reach. We carry a metallic circuit; that is, both positive and negative wires are carried underneath the slot rail. We do not use any ground return, and keep our circuit entirely free from grounds, thus nearly doubling the insulation on the motors. This wire is cut every 500 feet, and yet so arranged that it is still a continuous wire from end to end, so that you have a perfectly smooth surface. At every 500 feet we provide a hitch, and provide switches by which we can, if desired, cut out any one section of this line. If trouble should occur in one section you can cut out either the positive or negative in either track, and still run youur cars without any interruption. As Mr. Claude has said, this underground system is nothing more than the overhead system transferred from above the track. It is placed between the track, with suitable mechanical movements, and these mechanical movements are contained in the trolley and trolley carrier. The trolley carrier is fastened underneath the cars, and is so arranged that as the car is moving in one direction it will drop into a V-shaped slot, and that end of it is allowed to move back and forth to provide for the irregularities in rounding curves.

As the car is rounding a curve you cannot detect it by being in the car and looking at the trolley that it is on a curve. The trolley is made of half-inch steel, 4½ in. wide, with two trolley arms on the bottom suitably insulated. It is shaped in the centre to allow the wheel to move sideways, so that if the wire is not exactly straight, if it should happen to be further away than is proper, the wheel will move sideways far enough so that the trolley will remain on the wire. It has an elbow movement to facilitate the rounding of curves. It is impossible for the wheel to leave the wire at any point. We have run that road through all the different weather that we have experienced in Washington. We had quite a severe snow storm in March last, but we had no snow inside the conduit at that time, nor do I anticipate any trouble whatever from snow if the conduit is properly taken care of, simply running the broom through it once a day. It can be run through without any delay and keep the conduit free from snow. We have had two or three severe rail floods, and if you come to Washington to investigate this I will show you the high water mark where the water has covered the wires, and still the cars ran without delay. Last Friday we had a severe storm. I understand that the other trolley lines were shut down, from trouble with the overhead wires but the little underground road went right along without any difficulty whatever.

In reply to a question Mr. Law stated that there is a section of a mile and an eighth on the North Chicago line, running as a loop, which has been in operation since a year ago last March. It went through the winter pretty well. I will state, however, that that conduit is only 11 by 14 inches. It is only about one-half the size of the Washington conduit. They had some difficulty, I understand, in Chicago with snow, but the conduit was not taken care of properly. They used no sweeper; simply allowed it to run without any attempt, I believe, to clean it. In answer to inquiries Mr. Law said that the cost of construction is $35,000 a mile, and that there would be no difficulty in the matter of distance. There is no moisture in the conduit. If you will go there I will show you the ammeter in the power house, which should be a true indication of all current delivered to the generator that during all storms, if there is no car on the line using current, the ammeter goes absolutely to zero; showing that there is no leakage of current whatever; and during these times I have put on voltmeter tests, from wire to ground, and have only found one-tenth of one per cent. of leakage

### Heating and Lighting Street Railway Cars.

*Abstract of paper read at Milwaukee Convention.*

METHODS of heating and lighting street railway cars were considered in a report by Mr. G. F. Greenwood to the American Street Railway Association, in which are given results of investigations by the author in regard to the expense of several of the methods described.

Three methods of heating are discussed: First, primary heaters, or those in which heat is obtained from fuel consumed on the car; second, secondary heaters, in which the heat is generated elsewhere and transmitted through some storing medium in the car; third, electric heaters.

Good heaters of the first class can be purchased at from $15 to $24 per car, and can be installed at a cost of about $1.50 per car. The cost of operating these per car day of 18 hours, with fuel at $4.75 per ton, labor at $1.50 per day, and maintenance at 25 per cent. of the cost of stoves, is, for fuel, 8.7 cents; maintenance, 3.8 cents; labor 3 cents; or 15.5 cents per car per day. In the second method there are two types, one using steam, the other water. In the first steam is used to heat earthenware cylinders or tubes placed in iron pipes, and in the other heated water is forced into radiating tubes in the cars placed along or under the seats; a reservoir on the car is charged with steam or hot water at a chaging station. As this type of heating is stated to be at present in an embryo state, reliable figures are not given as to cost of operation. Electric heaters can be installed at a cost per car varying from $35 to $45. To keep the temperature at, say, 50 degrees Fahr. in moderately cold weather requires an expenditure of 2.66 h. p., and in severe wather from about 5.33 to 6.66 h. p.; estimating the cost of power to be .9 of a cent per kw.-hour (.7 cent per h.-p.-hour) the cost of heating a car per day of 18 hours, is given at 32.4 cents, 64.8 cents and 81 cents, respectively, on the above basis of power consumed. To these figures must be added 20 per cent. for depreciation and repairs, which will amount to about 5.1 cents more per day.

Considering all the elements that enter into the question of heating cars, the conclusion is arrived at that the best method is that of using a primary heater fired with anthracite coal and operated from the inside of the car.

Three methods of lighting street railway cars are mentioned, using oil lamps, the electric system and the gas system, and of these only the two latter are considered.

It is advised that an incandescent light be placed in each lamp box at the end of a car so that the signal light may be distinguished readily, and to illuminate the advertising rack over the window. On the ceiling there may be two incandescent lamps located about four feet from each end, and by having a divided circuit the fifth light can be used in headlights on the hoods of the cars. The result is that there is a minimum number of incandescent lights in the cars, the best lighting effect is obtained, and the annoyance of oil headlights and labor attending their use is removed. The cost of lighting by this method need not be over ½ cent. per hour, or four cents per car per day, estimating that the car uses its lights eight hours every day.

The third method, that of using gas, is well spoken of, but, owing to lack of experience, no data are given in regard to the same.

In conclusion the opinion is expressed that the best method of heating streetr railway cars is by the use of a primary heater or stove, and that for lighting, the use of such lights as can be secured in connection with application of electricity as a motive power, or a reliable gas system, provided the latter can be operated economically.

### Multiphase Motors and Systems.

The following, which is reprinted from the London "Electrical Review," may be of interest as an expression of foreign opinion on the discussion at the recent International Congress on "Multiphase Motors and the Transmission of Power."

The Electrical Congress, at Chicago, one would have supposed would have brought out something of interest regarding alternating current motors in general, and multiphase motors in particular.

It is a remarkable fact, however, that the official programme showed that no papers on the subject were to be read. A glance over the work actually accomplished by, and the papers actually read and discussed at, the Congress also shows that American electrical engineers declined to contribute to the discussions on multiphase motors, and in fact on almost all subjects of trade interest they were dumb. European electrical engineers were conspicuous by their absence. The usual professors were all there engaged in their usual kind of kite-flying papers and discussions. Papers by many of the learned professors are occasionally valuable and instructive, but are generally only entertaining, and are never of that kind which it is desirable to have at such a meeting as a great International Congress. Very few of the men actually engaged in electrical engineering practice were present; the men to whom the world owes the practical development of the dynamo, the electromotor, the transformer, the arc lamp, the incandescent lamp and many other important inventions, were not there. Yet these are the men who could have filled up the programme with interesting subjects. In their absence the professors got up a discussion on multiphase motors among themselves. Dr. Louis Duncan opened the discussion by recounting the advantages of multiphase motors; this was followed by what must have been a rather tiresome and somewhat showmanlike description of the Tesla multiphase system as exhibited in the Electricity Building. A hard-headed engineer, from California, then came forward and remarked that notwithstanding all that had been said about the perfection and beauty of their systems and machines for long distance transmission of power, none of them had established the commercial success of their schemes. "Only a year ago," says this engineer, "the first contract for definite transmission of power was closed and to-day the superintendent of the mine in which the installation was made is looking at his burned out field coils, after the generator has been in operation for less than 13 days."

The discussions which followed were not much better than twaddle; Prof. S. P. Thompson giving his opinion that multiphase motors would finally be abandoned in favor of single-phase motors.

Only once did the discussion become interesting, when Prof. Geo. Forbes intimated that it had been decided to use two-phase alternating currents for transmission and distribution of power from Niagara Falls. The arguments in favor of such a system are indisputable; it combines all the advantages of both the alternating and continuous current systems, and to a very great extent eliminates the faults of both.

The discussion then wandered off into the subject of frequency, and it was generally agree that low frequency was desirable for motor work, but that for lighting a limit is reached at 50 per second as the minimum.

We have already referred in our columns to this matter of frequency, and think that we have given good reason for fixing the lowest frequency at 60 and the highest at 72. The fixing upon one frequency for all alternating current work in public supplies is a matter requiring very urgent attention. Both in America and on this side electrical engineering progress is much hindered by the senseless employment of many different frequencies. In London we have a different frequency in the several installations supplying alternating currents; we have 65, 80, 100 and 133. This is lamentable, and leads to no end of trouble and unnecessary expense; so much so, that the adoption of one common frequency must, sooner or later, be made compulsory by some means. We believe the losses at the higher frequency will compel those supplying it to lower it to one-half at no distant date.

The resolution to adopt multiphase alternating currents at Niagara must be very satisfactory to those engineers who have worked upon this subject; they may yet hope to reap some benefits from their labors. Hitherto, in England, the public have been guided in their electrical engineering projects by two or three professors who have stereotyped plans for distribution of electricity, precluding the introduction of improvements. Still, there can be no doubt that an improved system will find its way into favor, and if the multiphase system is a success at Niagara it is likely to be adopted here in some places.

Prof. Forbes pointed out in his remarks on the Niagara scheme that two-phase current supply can be used for all alternating current work, whether single-phase or multiphase, and two-phase currents can be easily converted into continuous currents and vice versa; and he also stated the remarkable fact that two-phase alternators are cheaper than single-phase alternators for equal outputs.

Two-phase distribution of alternating currents has been advocated by Mr. Rankin Kennedy repeatedly in our columns. All the advantages have, from time to time, been set forth in communications to this journal; and a very excellent little treatise on the subject has been offered, for some time, from the pen of M. Hospitalier.

### A Gallant Savant's Definition of Electricity.

Prof. Galileo Ferraris, the genial Italian scientist, whose name is well known to all electricians, was recently asked by a young lady what electricity was, but, unlike most others when asked that question, he ventured to answer it, and according to "Cosmos," wrote in French in her autograph book the following, of which we venture to give a translation, even though the English language hardly does justice to the original in French: "Maxwell has demonstrated that luminous vibrations can be nothing else than periodic variations of electromagnetic forces, Hertz, in proving by experiments that electromagnetic oscillations are propagated like light, has given an experimental basis to the theory of Maxwell. This gave birth to the idea that the luminiferous ether and the seat of electric and magnetic forces are one and the same thing.

"This being established, I can now, my dear young lady, reply to the question that you put to me: What is electricity?

"It is not only the formidable agent which now and then shatters and tears the atmosphere, terrifying you with the crash of its thunder, but it is also the life-giving agent which sends from heaven to earth, with the light and the heat, the magic of colors and the breath of life. It is that which makes your heart beat to the palpitations of the outside world, it is that which has the power to transmit to your soul the enchantment of a look and the grace of a smile."

## Mr. Martin's Lawsuit—Its Object Cash, Not Vindication—Fruitless Exertion—Why and How It Failed.—V.

We commence this week with the defendant's side of the case, calling several men who were witnesses to Mr. Johnston's and Mr. Martin's conduct and actions in the printing office on that evening of Feb. 8, 1890, when Mr. Martin failed to put the paper to press.

The testimony of these witnesses presents a contrast with the details which Mr. Martin gave us under oath.

The incidents in the printing office were one and were really the only dispute between Mr. Martin and the defendants—whether Mr. Johnston interfered with him or took the make-up of the paper out of his hands.

Fortunately what Mr. Johnston did there was not observed exclusively by Messrs. Martin and Wetzler and the treasurer of the "Electrical Engineer." Others witnessed it and remained to relate what occurred.

The only other question in dispute was as to what Mr. Colvin was doing—whether he withheld the mails, especially whether he withheld them on that Feb. 8, and also whether he kept away the Kansas City Convention report during the whole of the week while Mr. Johnston was absent in Kansas City. To this we referred last week, and pointed out how strange it was that Mr. Colvin could have exercised such control over Mr. Martin's actions. Of course as to the last of these disputed questions, the defendants could not very well explain it. The facts as to it lay entirely between Mr. Martin and Mr. Colvin, and it would not have been entirely prudent for the defendants to have sought to have it cleared up through Mr. Colvin's testimony. Mr. Martin did not bring him forward to help to corroborate himself. Yet, as we showed last week, and as our report shows this week, Mr. Martin was on this point somewhat in need of aid and corroboration.

DR. LOUIS BELL, for the defendants, examined by Mr. Keigharn, testified that about the 14th or 15th of February, 1890, he entered into negotiation to take an editorial position on The Electrical World, and that the negotiations for his employment were finally closed about the 12th of March, 1890.

ALFRED E KORNFIELD, for the defendants, examined by Mr. Keigharn, said he was formerly employed by The W. J. Johnston Company, and was in its employ in the early part of the year 1890. On Feb. 8, 1890, at the request of Mr. Johnston, he went over to the printing office about the middle of the day, about 12 o'clock. He thought that Mr. Martin was there when he went over; yet he didn't remember exactly. He remembered seeing Mr. Wetzler.

Q. What were you sent there for? A. To see how things were progressing—whether the work was going on all right.

Q. When did you see Mr. Johnston afterward that day? A. Somewhere around four or five o'clock; it was between four and five. I left the office at four o'clock, or that time I am speaking of, and Mr. Johnston followed me outside.

Q. Where did you go to? A. I was going to the printers to give Messrs. Martin and Wetzler their respective salaries.

Q. When you got to the printers what happened there, as you remember? A. At five o'clock Mr. Johnston asked Messrs. Martin and Wetzler to stay and finish the paper. I believe that five o'clock was the hour of closing the pressroom. I think they left then.

Q. You heard Mr. Johnston ask Mr. Martin to remain and finish the paper? A. I can't say that I did; I believe I did. I have a vague recollection of this whole thing.

Q. Can you recollect what Mr. Johnston said to Mr. Martin when he got over there, about four o'clock? A. I think it was asking him to stay after five o'clock.

Q. What did Mr. Martin say? A. I don't remember.

Q. How soon afterward did Mr. Martin leave there? A. I think it was a very few minutes past five o'clock.

Q. How late did you stay there after that? A. I remained until nine o'clock that night.

Q. What were you doing there between five and nine o'clock?

Objected to. Objection overruled.

A. I went for Mr. Johnston to his house at the time to inform Mrs. Johnston that Mr. Johnston would not be home, and also to get Mr. F. E. Knight to come down to the printing office.

Q. When you came back was not Mr. Johnston engaged in getting the paper to press? A. He was engaged in reading proofs, I think.

Q. Was he not engaged in the general work of preparing the paper and getting it to press? A. Yes, sir. I stayed there until nine assisting also.

Q. When you went over to the printing office at 12 o'clock on that Saturday, did you hear any complaints from the printers of the want of work—that they had not been supplied with manuscript, or anything of that kind? A. I don't exactly remember. I don't remember just what the drift of that was—that is, I remember the drift of it—I don't exactly—

Q. I will ask what the substance of the complaints was? A. I don't know the exact substance. Mr. Weithas or Mr. Newman or someone else—I can't say who it was—said they thought they ought to get more work. Who that was I don't exactly remember.

Q. Did they say anything to the effect that Mr. Martin hadn't furnished them with the copy for the paper? A. No; they didn't mention names. They simply said they thought they could do more work if they had it. That was about the substance, I should say. But as far as I could see, they were working at the time.

Q. When Mr. Johnston went over to the printing office at about five o'clock, was Mr. Johnston angry?

Objected to. Objection overruled.

A. No, I don't think so.

Q. Did you hear Mr. Martin ask Mr. Johnston for instructions as to whether or not the paper was to go to press? A. I did not.

Q. You didn't hear or notice that Mr. Johnston refused to speak to Mr. Martin, did you? A. No, I didn't notice. I was busy myself some other way.

CROSS-EXAMINED BY MR. MASTEN.

Q. You say you were busy yourself attending to something else? A. I naturally would not want to mingle in with Mr. Johnston and Mr. Martin. I walked away as far as I could.

Q. And you, as I understand, don't remember hearing Mr. Johnston request Mr. Martin to stay there after five o'clock, and Mr. Martin decline to do so? A. Yes. Mr. Martin said, I believe, the pressroom was closed now and the men would not work after five o'clock—that was about the drift of it. Then I think they left, Messrs. Martin and Wetzler.

Could there be any plainer contradiction of Mr. Martin than is embodied in this answer to his own lawyer? Mr. Martin is distinctly contradicted by all of Kornfeld's testimony as to what passed between him and Mr. Johnston at the printing office, and also as to what he swore was the fact—that Mr. Johnston was angry.

Q. Do you recollect whether anything was said by Mr. Johnston to Mr. Wetzler at this time?

Mr. Keigharn: I object. Objection sustained.

Q. Are you sure that it was not Mr. Wetzler that Mr. Johnston asked to stay after five o'clock? A. I am not.

The concession or admission which is clearly implied by this question of Mr. Martin's counsel is something extraordinary. All the more so, as Mr. Wetzler swore positively that Mr. Johnston at no time on this afternoon spoke one word to him. Were they really willing, at this desperate moment, for the purpose of propping up Mr. Martin, to have Mr. Wetzler knocked down?

MR. KEIGHARN: After Mr. Martin left at five o'clock on that evening, Feb. 8, how many men remained there—printers, or compositors? A. Five or six. They remained until nine o'clock.

Frank P. Newman, for the defendants, examined by Mr. Keigharn, said he was and is foreman in the printing office of Mr. Wm. P. Atkin. He was employed there during February, 1890. He remembered Saturday, the 8th of February, 1890. Mr. Atkin sets up the type of The Electrical World. He remembered that it was the general supposition that the paper was to go to press on the 8th of February, although they had no real orders to that effect. It did go to press that evening, between 9 and 10 o'clock. The reason it was issued without editorial notes was because no editorials were in type.

Q. Did Mr. Martin furnish you with any editorial copy on that day? A. Not that I can recollect of.

Q. Mr. Martin has said here that before he left the office, at about five o'clock that Saturday, he handed you the editorial notes. Is that true?

Objected to. Question allowed.

A. I have no recollection that he furnished me any editorial copy on that Saturday. I don't think he did. I would probably recollect if he had.

Q. You remember Mr. Johnston coming to the office about five o'clock that Saturday evening? A. Yes, sir.

Q. Who was there when Mr. Johnston came? A. Mr. Martin and Mr. Wetzler were both there.

Q. When Mr. Johnston came in there did you hear him say anything to Mr. Martin? A. I heard him talk to Mr. Martin and tell him the paper ought to be got out, something to that effect. I can't quote just his very words.

Q. Anything else? A. That is all I heard Mr. Johnston say to Mr. Martin.

Q. Did you hear Mr. Martin make any reply? A. Yes.

Q. What reply did he make? A. I didn't hear the whole of his reply. The substance of it as far as I heard it was that he had been to work on the paper, didn't feel very well, and it was almost impossible to get it out.

Q. Did he say anything about being sick or anything like that? A. He might have made the remark he was not well. I think he did; although just the language he used I don't know. That occurred, I think, at a little before five o'clock.

Q. After that conversation took place between Mr. Martin and Mr. Johnston did you see Mr. Martin make any further efforts to speak to Mr. Johnston? A. They had some words. I was not near enough to hear them. They had the appearance of two men saying something to each other. What they said I don't know.

Q. Did Mr. Martin follow Mr. Johnston all round the office, or around the stones, as they say, and try to secure instructions from Mr. Johnston as to issuing the paper, and did Mr. Johnston run away from him? A. They were both at the desk in the middle of the floor. I didn't see any one follow the other, or see them chase each other.

Q. Was Mr. Johnston angry—so angry that he would not speak to Mr. Martin? A. I don't think he was. I don't know whether he was angry or not.

Q. Was he wild? Was he furious? A. No way wild at all, so far as I could see.

Q. Mr. Martin has said here that Mr. Johnston on that occasion refused to give him any instructions as to the issue of the paper, would not answer his questions, was angry, was wild, acted like a wild cat, ran around the place. Did you observe anything in Mr. Johnston's actions on that day which would warrant your believing such was the case? A. As to answering his questions, that I could not say anything about. What I have testified is as I have seen them.

Q. What was his manner? What were his actions? A. About his usual manner. Perhaps he looked as determined as ever. I didn't notice he was angry. I didn't notice anybody was angry.

Q. Did you hear Mr. Johnston make any request of Mr. Martin to stay there and issue the paper? A. I did not.

Q. Did you hear Mr. Martin refuse to remain there? A. No.

Q. What time did Mr. Martin leave there? A. I should judge it was anywhere from 15 to 20 minutes past five. It might have been 10 minutes past five; it might have been five minutes later. It was very shortly after I saw Mr. Johnston in there first.

Q. How long did you remain there after Mr. Martin left? A. I remained until the paper went press.

Q. What time was it when the paper went to press? A. I think it was between 9 and 10 o'clock; although I could not be certain. It was along about that time.

Q. After you saw Mr. Johnston speak to Mr. Martin the only thing you heard Mr. Martin say in reply was that he was not feeling very well and it was impossible to issue the paper? A. That and something about he had been so long to work on the paper—something like that—I didn't catch the whole of his remarks because the moment Mr. Johnston spoke to him I walked away.

Q. You had men working there in the office on the paper until about half-past nine o'clock? A. Yes, sir, about that; up until it went to press.

Q. I understand you to say you were foreman of the office? A. Yes, sir.

Q. If you had had those editorials at four o'clock, could the paper have been put to press before six? A. I should say not.

Q. How late would you have had to remain there if you had had the editorials? A. It certainly would have taken two and a half or three hours, perhaps three and a half hours, to complete it all and get it ready for press.

Q. If you had had those editorials at four o'clock, do you know of any objection why the paper could not have been put to press before eight or nine o'clock that night? A. I don't know of any objection, only that the work was not far enough advanced.

Q. You mean the editorial work? A. The general work on the paper.

Q. You reissued the paper on the following Monday, as I understand you? A. Yes, sir.

Q. You received editorial notes to be printed in the Monday issue? A. Yes, sir.

Q. From whom did you receive them? A. I think from Mr. Martin and Mr. Wetzler, or Mr. Martin might have handed them in.

Q. What time on Monday did he hand you those notices? A. Along in the forenoon, as near as I remember; I should think it was nine o'clock; it might have been a half-hour later.

Q. What time on Monday was the paper issued? A. As far as I can recollect it, it was sent to press that afternooon again and it was printed during that night, and published the next day.

The whole of this testimony of Mr. Newman is an emphatic contradiction of that of Mr. Martin. He contradicts him even wherein he swore that the paper was issued that same evening (meaning Monday evening) and sent to Kansas City by his orders. Mr. Newman here says it was not published until Tuesday. Every other witness who knew anything about it said the same as Mr. Newman.

Q. Did you see Mr. Johnston, when he came in there at five o'clock on Feb. 8th, go and take possession of Mr. Martin's desk? A. No, I can't say that I did; although he was at the desk after Mr. Martin went.

Q. He was not at it before Mr. Martin went away from there? A. I don't recollect that he was. I don't think he was. He might have been standing there. That is, he was not sitting down at the desk, according to my recollection.

Q. Did you see Mr. Johnston grab copy off the stones there and take it away from Mr. Martin? A. No, I didn't see him take anything away from Mr. Martin. He had proofs in his hands that were lying down on the stones.

Q. Do you know what work Mr. Johnston did after Mr. Martin and Mr. Wetzler left there? A. He went on to supervise the make-up of the paper.

Q. He performed the same work Mr. Martin would have performed if he had put the paper to press, didn't he? A. Except that there were no editorials.

Q. When Mr. Johnston came in there, did he ask you in the presence of Mr. Martin whether the paper was going to press or not? A. No, not in the presence of Mr. Martin, not within Mr. Martin's hearing, as far as I recollect it.

Q. Did you see Mr. Martin recently? A. I have not seen Mr. Martin to speak to him for, I guess, over a year now.

Q. You saw him some time after he left the employ of The W. J. Johnston Company? A. I saw him a number of times.

Q. Did you ever have any conversation with him in reference to—

A. Not to any great degree.

Q. He spoke to you, didn't he, about what happened over there on Feb. 8? A. Yes, sir.

Q. I understand you to say you had a conversation with Mr. Martin about the occurrences of Feb. 8? A. Yes.

Q. What did Mr. Martin say to you?

Objected to. Question allowed.

A. I don't know as I can recollect much of what he did say. It was of a general character. He wanted to know how far I recollected the circumstances. I told him about as I am telling you here.

And notwithstanding all that, Mr. Martin did not call Mr. Newman as a witness. He preferred to try his luck with his own version of what occurred.

CROSS EXAMINATION BY MR MASTEN:

Q. You were foreman at Mr. Atkin's office? A. Yes.

Q. Where The Electrical World is still published? A. Yes, sir.

Q. And you are still in Mr. Atkin's employ? A. Yes.

Q. What were your duties as foreman, so far as concerned the printing and publication of The Electrical World? A. The general supervision of the copy as it came in and as it was made up and sent to press.

Q. How far did those duties bring you into connection with Mr. Martin? A. They brought me into direct connection with Mr. Martin. All this copy for his paper was supposed to be handed to me, or I was supposed to supervise it, before setting it into type.

Q. And he was over there every week, more or less? A. Yes, sir, every week without any exception that I know of while he was on the paper.

Q. And every day? A. No, not as a general rule every day; perhaps three or four times a week.

Q. On the day when the paper went to press was he there more or less continuously? A. Generally the best part of the day; except when he went to lunch or had some other business.

Q. Where did he make his headquarters when there? A. He made his headquarters right on the floor where the paper was made up. In the composing-room. We have two floors. I am supposed to see to both of them. His work was on the lower floor. I was in and out there as much as upstairs.

Q. How large a room was this? I should judge it was 60 by 35. I had quite a number of men under me in the office, in that room where Mr. Martin was. There was no presswork done there.

Q. Do you recollect on this day of which you have spoken, the 8th of February, whether Mr. Martin was there all day? A. Yes, sir, according to my recollection he was there all day, with, perhaps, one or two intermissions when he went out for a short while.

Q. And you were there all day yourself? A. Yes, sir.

Q. In the office? But were you not all day in the room where he was? A. Not all day in the room where he was.

Q. So far as your observation went, was Mr. Martin busy during the day? A. He appeared to be, as far as I observed anything.

Q. What was he working on, did you know or did you observe? A. That I could not tell. He seemed to be working on general work of the paper as usual. He had the proofs and copy on the desk.

Q. Did you put in type a considerable amount of matter on that day for the World? A. Yes, sir.

Q. What was it, do you recollect? A. I can't recollect.

Q. Do you recollect whether it was more or less than you usually put in type on the day when the paper went to press? A. I should judge it was a little more, on account of the paper going to press one day earlier.

Q. Would the fact that the paper went to press one day earlier than usual make any difference in the amount of labor involved in your office for all concerned? A. Yes, sir. We would have to do about the same amount of labor with so much less time to do it in.

Q. Do you know whether or not there was any delay on that day in the receipt of any of the cuts which were to be used for that issue of the paper? A. I think there was a delay, although my recollection is not distinct enough to so state.

Q. I understood you to say that you got no editorial matter from Mr. Martin at all during that day? A. Yes, sir; I did not.

Q. Do you know what the reason of that was? A. No.

This question strikes us as very odd. If this lawyer gave any credit to what his own client said—"I believe I handed them (the editorials) to Mr. Newman"—how did he expect or suppose Mr. Newman could know of the existence of a reason why they were not given to him?

Q. Are you able to say whether or not he wrote any editorial matter on Saturday? A. That I could not say. He might have been writing editorial matter or almost anything else.

Q. Do you have any recollection as to what time the mail matter was sent over from the business office to Mr. Martin? A. No, sir. That would be entirely out of my jurisdiction.

Q. When Mr. Johnston came over about five o'clock I understand you to say that you didn't stand and have any particular conversation with Mr. Martin and Mr. Johnston? A. Only as far as I have testified.

Q. And when they began talking, as I understand, you said you turned and walked away? A. Yes, sir.

Q. Were you after that busy with your own affairs or did you watch them? A. I didn't particularly watch them. I was paying off on the floor. I had the envelopes in the box and was going on with it, as far as I recollect, or I might have just got through.

Q. Is it not possible that they might, either one or the other of them, have said a good deal you didn't hear? A. Yes, sir; they might have said a great many things.

Yes; they might have said anything or everything. But this witness was not called to testify as to what *might* have been said or done. He was there to testify to what he *knew* was said and done. He waited away from his other duties long enough to enable him to know that; and he testified to enough on that point also; and Mr. Martin must have thought the witness knew *enough* when he went to interview him to find out what he did know, and then did not call him as a witness. But why the lawyer should get it into his head that "either *one* or the *other* of them" might have said a great deal which Mr. Newman did not hear, when his own client swore that Mr. Johnston said nothing—would not speak to him—is something beyond our powers of comprehension. Mr. Martin's oath on that point ought to have satisfied his own counsel. Apparently it did not.

Q. Who made up the new paper that was put to press on the following Monday? Who supervised it in the printing office from the editorial staff? A. Both Mr. Martin and Mr. Wetzler.

Q. I understood you to say that Mr. Martin gave you the editorial matter Monday morning? A. Yes, sir.

Q. Do I understand that you noted when Mr. Johnston came in the office no appearance of excitement whatever on his part? A. Certainly, he didn't appear to be very much excited, as far as I could see.

Q. Did you notice either in his appearance, in his tone or in his manner, any evidence whatever of anger? A. I could not say that I did; no, sir. He seemed to be in a hurry. That is about all.

Q. Nor any evidence of surprise that the paper was not out? A. No, sir. I didn't study him particularly to give a description in person how he looked and how he acted at that time; I was busy.

Q. You were busy and attended to your own affairs? A. Yes, sir; I tried to.

Q. Do you remember any messages being sent back and forth from your composing-room to the business offices of the World that day? A. What do you mean? Do I remember—

Q. Do you remember the fact that messages came and went, or that they were telephoning or anything of that sort? A. I don't know as I noticed there was anything of the kind going on; as a general thing there is when getting out a paper. I could not say.

Mr. Martin said all that was done through Mr. Colvin. He was just the man to prove about this and other things. Why did they not call him to do so?

Re-direct Examination by Mr. Keigharn.

Q. On the day on which the paper usually went to press was Mr. Johnston in the habit of going over there to Mr. Atkin's office? A. Not as a general thing.

Q. He used to leave Mr. Martin in entire charge of issuing the paper? A. As a general thing, as far as our office went.

Q. Up to five o'clock on Saturday evening Mr. Johnston was not in the printing office? A. No, sir; I didn't see him there.

Q. Do you know of anything that Mr. Johnston did on that Saturday afternoon which in any way interfered with Mr. Martin in issuing the paper? A. I didn't see him do anything.

No; Mr. Newman "didn't see him do anything," because things which have no existence, except in imagination, cannot be seen. And it is safe to assume that when Mr. Martin had his interview with Mr. Newman soon after the occurrences, he was not able to recall and fix in Mr. Newman's mind anything which he had seen which would have been of the slightest aid or support to Mr. Martin's case.

Dewitt W. Smith, for the defendants, examined by Mr. Keigharn.

I am a printer and was employed in February, 1890, by Wm. P. Atkin, as a compositor. My work was principally on the lower floor of the shop. I remember Feb. 8, 1890. I remember Mr. Johnston coming over there on Feb. 8 at about a quarter of five or ten minutes of five. I saw Mr. Martin and Mr. Wetzler there when Mr. Johnston came there.

Q. What occurred between Mr. Johnston and Mr. Martin at that time? A. Well, Mr. Johnston advanced to where Mr. Martin and Mr. Wetzler were and held some conversation.

Q. Did you hear any of the conversation? A. No, sir; not that I can recollect.

Q. Did you hear Mr. Johnston ask Mr. Martin anything? A. As I was passing them on the way upstairs I heard Mr. Johnston place a query as to whether the paper was coming out that night. I couldn't say whether he asked that directly to Mr. Martin or to whom.

Q. How near was he to Mr. Martin when he asked that question? A. I should judge he was within four or five feet when he made the query.

Q. Who was in the immediate vicinity of Mr. Johnston and Mr. Martin? A. Mr. Wetzler was very near; about the same distance.

Q. Were Mr. Johnston, Mr. Martin and Mr. Wetzler the only ones that were there? A. Mr. Johnston, Mr. Martin and Mr. Wetzler; I was passing.

Q. Did you hear any reply made by anybody to that question of Mr. Johnston's? A. I heard Mr. Wetzler make the remark that it didn't look much like it. I don't know whether he made the remark to himself or to Mr. Johnston.

Q. Did you hear Mr. Johnston say anything further? A. Not that I heard; not to them.

Q. How long after that did you remain there that night? A. Until between 9 and 10 o'clock.

Q. Did you see Mr. Martin leave there after you heard Mr. Wetzler make the remark that you testified to? A. Yes, I saw Mr. Martin and Mr. Wetzler both leave.

Q. At about what time? A. I should judge it was within a few minutes after five—within 10 minutes after five.

Q. How long did Mr. Johnston remain there? A. Until the paper went to press.

Q. What was he doing then? A. He was doing the general work of supervising the make-up of the paper.

Q. Do you know whether Mr. Martin was out of the office at all on the 8th of February? A. I think he was out to lunch that day a little while.

Q. About how long was he absent, if you recollect? A. I don't think he was absent more than half or three-quarters of an hour.

Q. In the work of the office on that 8th of February, was the work of putting the paper to press moving rapidly or slowly, in your judgment? A. I should think it was taking about its usual course.

Q. Did you notice how Mr. Martin was working on that day? A. I didn't notice anything in his way of working that I had watched for the last three or four years prior.

Q. Was he working all the while, or was he engaged in conversation? A. Various times Mr. Wetzler and he were engaged in conversation.

Q. Were you in the office on the Monday morning following, when Mr. Martin came in there? A. I was.

Q. What did he say when he came in that morning?

Objected to. Question allowed.

A. He looked around and saw that the forms weren't there, and he made the remark that the paper had gone to press. Mr. Newman said yes, it had been put to press. Mr. Newman said that Mr. Johnston had ordered it. Then he ordered Mr. Newman to place the forms on the stone in the same condition that they were when he left there on Saturday; that he would make up the paper.

Q. And the paper was made up the second time? A. The second time on Monday.

Q. What time did the second paper go to press? A. I think about its usual time, about five or six o'clock; about six o'clock.

Q. Six o'clock on Monday evening, Feb. 10? A. Yes.

Q. What time was it ready for distribution? A. That I don't know; the pressroom would have to do with that. It couldn't be before the following morning.

This contradicts Mr. Martin, where he swore that it was got to press by "midday; very swiftly," and was sent to Kansas City "early in the afternoon of Monday by my orders;" but every witness contradicted him on this point, even Mr. Wetzler.

Q. How long have you been working in Mr. Atkin's office? A. Pretty near eight years; between seven and eight years.

Q. Has The Electrical World been put to press there during all that time? A. Yes, during my period there.

Q. I mean you have set up the type for it? A. Yes.

Q. On the publication day of the paper was it the usual thing for Mr. Johnston to appear there in the office, or otherwise? A. No. I hadn't seen Mr. Johnston, I guess, in two years before that day.

Q. You mean on the 8th of February? A. On the 8th of February.

Q. You hadn't seen him in the office at all? A. No.

Q. Mr. Martin always had charge of seeing that the paper went to press, didn't he? A. Yes, Mr. Martin had the general charge of it.

Q. When Mr. Johnston came in there on the 8th of February, was he calm? A. I don't know how to answer that. He didn't seem to be anyway—I don't know how to express myself. He seemed to be cool and collected.

Q. Had he the appearance of being displeased? A. He looked and acted as if he was very much disappointed.

Q. At what? A. At the paper not going to press.

Q. Did he express any surprise to anybody in your hearing? A. He remarked to Mr. Newman that he was very much surprised; that he supposed the paper was to go to press that night.

Q. The paper which Mr. Johnston put to press that night and which you have been referring to had no editorial notes, had it? A. None whatever.

Q. Had you known an instance before in the history of the paper when those editorial notes had been omitted? A. No, sir; not in my recollection.

Cross-Examined by Mr. Masten.

Q. What did I understand that your position was? A. Well, I am compositor, but I am called upon to do the general work of the place.

Q. You were on this 8th of February attending to your usual business, were you not, in the office? A. Yes. It was my custom on the publication day of The Electrical World to work on the make-up.

Q. You didn't give any more especial attention to the movements of Mr. Martin on that day than on any other publication day, did you? A. No.

Q. Have you any special reason for stating it to be your recollection that Mr. Martin went out to lunch that day, or is it simply a recollection that he generally went out to lunch in the middle of the day? A. He generally went out; and I am almost positive he went out. I went out myself that day between 12 and 1, and when I came back I am positive that Mr. Martin and Mr. Wetzler went out.

Q. What is your means of recollection on the subject? A. I can't call to mind any specific point.

Q. If Mr. Martin says as a matter of fact that he didn't go out to lunch on that day or hour, would you have reason for believing that not to be correct? A. I wouldn't like to dispute him.

Re-Direct Examination by Mr. Keigharn.

Q. During the time Mr. Martin remained there after Mr. Johnston came, did you hear Mr. Johnston say anything to Mr. Newman? A. Well, more than I heard him say to Mr. Newman: "I am very much surprised that the paper has not gone to press," as he understood it would go; and he said: "It must go to press."

Q. Did you see anything in Mr. Johnston's conduct that day that would in any way interfere with Mr. Martin? A. No, I did not.

Re Cross-Examination by Mr. Masten:

Q. I understand that you did not hear the entire conversation between Mr. Martin and Mr. Johnston on that day? A. I did not.

Q. You had your own business to attend to, and did not stand to hear? A. I minded my own business.

Q. They might have said a great deal that you did not hear? A. They could have done that.

Q. As I undersand, all that you heard of the conversaton were some passing remarks when you were on your way up stairs? A. Yes.

Q. How long did you remain upstairs.? A. About two or three minutes.

Q. When you came down did you go to the place where they were talking? A. I branched off in another direction.

Re-Direct Examination by Mr. Keigharn:

Q. After you came down stairs how long did Mr. Martin remain there? A. I should think about ten minutes.

Q. Was Mr. Johnston close to him all the time after you came down? A. I should judge within speaking distance.

Q. Was Mr. Johnston engaged in doing anything? A. No, except standing there and looking with a sort of amazed look.

Leicester Allen, an editor of several years' experience on technical journals, testified as to the duties of an editor in remaining at his post until the paper went to press.

Louis E. Gallison, another editor of several years' experience on trade papers, and the president of the American Trade Press Association, testified also as to the duties of an editor to remain at his post until the paper went to press.

Richard L. Weithas, for the defendants, examined by Mr. Keigharn:

I am a printer. In February, 1890, I was employed at Mr. Atkin's as assistant foreman. I saw Mr. Johnston at the office of Mr. Atkin Saturday, Feb. 8, 1890, about a quarter to five, I should think, to the best of my recollection. Mr. Martin and Mr. Wetzler were there when Mr. Johnston came in. I had a conversation with Mr. Martin on February 8 in regard to the make-up, as we call it. I had been told it was the intention to have the paper go to press on Saturday.

Q. During the day did you observe, or see, anything which led you to believe that it wouldn't go to press on that Saturday? A. I saw it was impossible to go to press that day.

Q. About what time of day did you see that? A. Well, I could see that about—Well, now I should guard myself in saying that. I saw it was impossible for it to go to press that day, and get out at five o'clock.

Q. What time did you notice that? A. I say I could see that at ten o'clock in the morning.

Q. After you noticed that did you speak to Mr. Martin about it in any way? A. I told Mr. Martin that I thought we could not get it out.

Here is evidence that it was noticeable at ten o'clock on that morning that the paper could not be got out that day, and Mr. Martin's attention was called to that fact. Yet Mr. Martin never informed Mr. Johnston about it. He does not even claim that he informed the "safe and reliable" Mr. Colvin of that fact. Mr. Johnston was in blissful ignorance, relying on Mr. Martin, who he was paying at about the rate of $18,000 a year, as Mr. Martin himself figured it out. All these printers swore that Mr. Johnston never appeared at the printing office—took no part in putting the paper to press—relied on Mr. Martin for that. And why shouldn't he?

Q. Did you complain to him for any reason? A. I told him things were very slow.

Q. Did you ask him about the absence of any copy

which he should have furnished you? A. I spoke to Mr. Newman, not to Mr. Martin.

Q. You spoke to Mr. Newman? A. About copy.

Q. Was Mr. Martin present when you spoke to Mr. Newman? A. Mr. Newman was upstairs at the time.

Q. What was your reason for speaking to Mr. Newman? A. Mr. Newman was my superior.

Q. What were the complaints you made to Mr. Newman? A. I told him we were not getting along, and were not doing the work necessary; that we hadn't any editorial copy.

Q. Did you communicate that fact to Mr. Martin after that? A. I have an idea I did. Yes, I am quite positive I did.

Q. What did Mr. Martin say? A. He said he knew it.

Q. Did he make any excuse for the absence of the editorial matter? A. Not at the time.

Q. Well, afterward? A. No, sir.

Q. Did he say anything in reference to feeling ill, or having a headache? A. Yes, he told me that he had a very severe headache, and it was being doctored for at the time.

Q. Did he give you any reason as to why that editorial copy had not been furnished for the printers? A. Mr. Martin told me it was in connection with his headache. He told me he had been working preparing articles for the paper, and for the two preceding nights had been sitting up all night, and had sickness in his family in addition to that.

Q. Was there any delay on that 8th of February from the fact that you had not been furnished with the copy that was needed for the paper? A. I don't know whether that was the cause of the delay, but there seemed to be a delay on everything that day. That was one of the causes, most certainly.

Q. How long did you remain in the shop after Mr. Johnston came there? A. Just long enough to put on my coat.

Q. Do you know when Mr. Martin left? A. I don't know; not positively.

Q. What time did you get back to the shop? A. Probably about a quarter to six.

Q. How long did you remain there? A. Till ten o'clock, I should think.

Q. When you went back Mr. Martin was not there? A. Mr. Martin was not.

Q. How long did you say you had been employed in Mr. Atkins' office? A. Close on to seven years.

Q. Was it usual for Mr. Johnston to appear there on the publication day of the paper? A. I had never seen him there before. It was the first occasion I saw Mr. Johnston at the office.

Q. Was he angry when he arrived there? A. Well, he didn't look very much pleased.

Q. Did you hear him make any remarks as to the paper going to press? A. I did not.

CROSS-EXAMINED BY MR. MASTEN:

Q. Did you hear Mr. Martin make any remarks to Mr. Johnston on the subject? A. No, sir; I heard no conversation between them of any kind.

Q. Where were you when Mr. Johnston came there and met Mr. Martin? A. Working at the paper, at the stone.

Q. Was Mr. Martin, so far as your recollection goes, occupied during that day with the usual business of the office? A. He attended to his business, yes—to the make-up of the paper.

Q. Do you recollect whether or not one reason of the delay was difficulty in obtaining a cut or cuts for something on the advertising pages? A. I only know of one cut early in the day, and we allowed space for that and went ahead without it.

Q. Do you know what the reason was of the failure on Mr. Martin's part to have the editorial part ready early in the day? A. No, sir; I haven't the slightest idea.

RE-DIRECT EXAMINATION BY MR. KEIGHARN:

Q. Can you specify what cut it was that was absent from the reading pages? A. Well, I couldn't specify from my knowledge at the time, but from what I learned afterwards I learned what the cut was. There is the cut (pointing to cut on page 115 of the paper).

Q. Do you know what time that came into Mr. Martin's hands? A. I do not; no, sir.

Q. It was put in the paper, wasn't it, that Mr. Johnston issued on that afternoon? A. This, I believe was the edition. It went into the one that Mr. Johnston issued.

Q. Do you know whether it was in the office as early as three o'clock on that afternoon? A. I think it was before that.

Q. And you say that you had reserved a space for it all day? A. The page was made up early in the day, yes.

G. L. FOOTE, JR., for defendants, examined by Mr. Keigharn: I live in Brooklyn. I am employed by the W. J. Johnston Company, Limited, as a bookkeeper. I was in the employ of the company in the month of March, 1890. I was in the business office of the company on the 5th of March, in the forenoon. I know there was some trouble there.

Q. Do you know whether or not Mr. Martin received notice of discharge from his employment? A. I believe he did.

Q. Do you remember whether or not this trouble you referred to occurred on the same day he received the notice? A. Yes, it did.

Q. Now, will you go on and state what the trouble was, if you can remember it? A. For which he received his discharge?

Q. I mean the trouble which occurred at about noontime on the 5th of March, or the day he received his discharge. A. Well, I believe Mr. Martin was ordered to his room by Mr. Johnston.

Q. What was the trouble at that time between Mr. Johnston and Mr. Martin in the business office of the W. J. Johnston Company? A. Mr. Wetzler and Mr. Martin were talking, and Mr. Johnston came in and told Mr. Martin, after speaking a short time with him, to go to his room.

Q. Was there a quarrel between Mr. Johnston and Mr. Wetzler at that time?

Objected to; Question allowed.

A. I say that what was said was said so quietly that I had no means of telling what they were talking about.

Q. What was Mr. Wetzler engaged in doing in the business office at the time this trouble arose between Mr. Johnston and Mr. Martin, immediately before Mr. Martin came out?

Objected to; Question allowed.

A. He went into Mr. Johnston's room in a very short time and walked into the general office, and was engaged in talking with Mr. Johnston; and Mr. Martin walked up and talked with him a few minutes, and Mr. Johnston ordered him to his room.

Q. Was Mr. Wetzler engaged in examining any books at that time?

Objected to; Question allowed.

A. Not at that time.

Q. Was there a bookkeeper in there—an accountant—examining the books at that time? A. There was.

Q. Do you know who brought him there? A. Mr. Wetzler.

Q. How long had he been engaged in examining the books—I mean before Mr. Wetzler went to Mr. Johnston's room? A. Well, the circumstances which led Mr. Wetzler to go to Mr. Johnston's room was—

Q. Please answer the question. How long was this bookkeeper engaged in examining these books before Mr. Wetzler went to Mr. Johnston's room? A. I should say about 15 minutes.

Q. As I understand, this bookkeeper applied to you for the books? A. Mr. Wetzler came out and introduced him to me, and Mr. Wetzler pointed to the books and told him to look through them; and he had been there about 15 minutes when Mr. Johnston came out and called him into his room, and then Mr. Wetzler came out and went into Mr. Johnston's room, and was there a short time; and the three of them came out into the general office and talked for a short time, and Mr. Martin joined them.

Q. Immediately before Mr. Martin joined them were there any words between Mr. Wetzler and Mr. Johnston? A. If there were I did not hear them.

Q. Did you notice from their actions whether there was any quarrel between them? A. I couldn't say.

Q. While Mr. Wetzler and Mr. Johnston were speaking Mr. Martin came out from his own room, from the editor's room to the general office? A. That is it.

Q. Did you hear Mr. Martin say anything when he came out? A. He began talking with the others; I didn't hear what he said.

Q. Mr. Johnston requested him to go to his room? A. Yes.

Q. Did he comply with the request? A. No, sir.

Q. He remained there after he was ordered to go to his room? A. Yes.

Q. Where did Mr. Johnston go then? A. He stayed there for a short while, and then went into his room.

Q. Mr. Martin was still in the outer office? A. Yes.

GEORGE M. PHELPS, president of the corporation publishing the "Electrical Engineer," testified that Mr. Martin and Mr. Wetzler were the editors of the paper called the "Electrical Engineer," and had been such since about the end of April, 1890. That the "Electrical Engineer" is a rival in every sense of the word of The Electrical World, as all journals occupying similar fields are rivals. That Mr. Martin's salary as editor of the "Engineer" from the first of April, 1890, to the end of 1890, was at the rate of $2,600 a year, and that he received no other compensation outside of his salary.

From Mr. Phelps' testimony it appears that Mr. Martin joined the "Engineer" about April, 1890. Mr. Wetzler went with the "Engineer" at the same time. They were discharged from their employment on The Electrical World on March 5, 1890. It did not take long for them to make up their minds as to where they were going and what they were to do. The "Engineer" evidently was ready to receive them, and as Mr. Martin's testimony showed, it also apparently was already to receive all the other employees of The Electrical World who came along or whom he could induce to come along. How the "Engineer" had all these positions vacant and ready to be filled seems a little strange. There is nothing in the case to show that the matter was all arranged beforehand, but the "Engineer" acted with dispatch when the opportunity presented itself, and Mr. Martin apparently settled right down to business at the modest recompense of $2,600 a year until the letter of June 7 came along, and from that time on he devoted some of his time to "vindication." Had he devoted himself exclusively to the task of making his paper rival The Electrical World, we and others engaged in the e lectrical business world would have welcomed him in his new efforts.

## Transformer Testing.—II.

BY HENRY H. NORRIS.

There are two methods of measuring efficiency, tried by Dr. Fleming,* which, although troublesome in practice, should yet be examined. These methods use but few in-

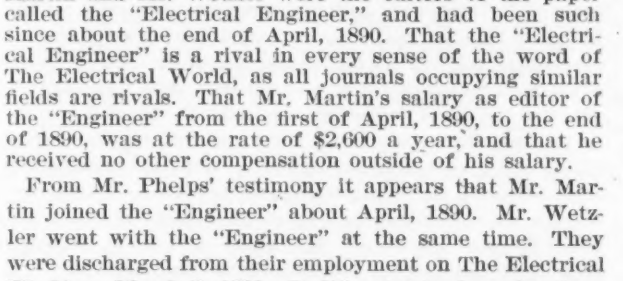



FIG. 6.

strum ents, and are known as the three voltmeter and three ammeter methods. The instruments used in this case were Swinburne's electrostatic voltmeters.

Electrostatic voltmeters in general consist of charged, movable vanes, moving between plates charged oppositely by connecting to the circuit terminals. The only difference between them and Thomson's quadrant electrometer consists in the large number of vanes.

In the voltmeter method two transformers have their secondaries in series to give the required voltage and the primary of the transformer under test is connected in series with a non-inductive resistance.

* See The Electrical World, Dec. 28, 1892; "Phil. Mag.," August, 1891, and "Transactions Royal Society," Vol. 49, April, 1891.

The power given to such a circuit is $\frac{1}{2r}(V^2 - V_1^2 - V_2^2)$. If $v$, $v_1$ and $v_2$ are the falls of potential at a time $t$,

$$v = v_1 + v_2 \qquad (1)$$

If $\alpha$ = current at time $t$, $\alpha\, v_1$ = watts given to inductive resistance.

$$\text{But } \alpha = \frac{v_2}{r} \qquad (2)$$

Substituting for $\alpha$ its value in (2) we have

$$w = \frac{v_1 v_2}{r}$$

Squaring (1)

$$v^2 = v_1^2 + 2\, v_1\, v_2 + v^2$$

$$\therefore w = \frac{1}{2r}\left(v^2 - v_1^2 - v_2^2\right.$$

$$\int_0^t w\,dt = \frac{1}{2r}\left(\int_0^t v^2\,dt - \int_0^t v_1^2\,dt - \int_0^t v_2^2\,dt.\right.$$

Now, since the voltmeters read $\int_0^t v\,dt$ we have $w = \frac{1}{2r}(V^2 - V_1^2 - V_2^2)$.

The resistance of the non-inductive resistance ($r$, Fig. 6)

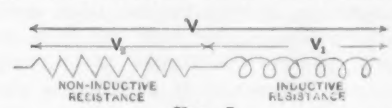



FIG. 7.

being known the current used may be calculated knowing the fall of potential through it by means of $v_{111}$. This gives the power absorbed by the primary while the power given out may be measured in the usual way.

The power factor (cos $\alpha$) by which it is necessary to multiply $cv$ in order to get true watts equals,

$$\frac{V_1^2 - V_1^2 - V_2^2}{2\, V_1\, V_2}.$$

The three-ammeter method* is very similar to the above, the only difference being in the use of ammeters for voltmeters.

Theoretically three ammeters are required, but by placing a bank of lamps the resistance of which has been determined, one ammeter may be discarded. By switching the bank of lamps from one side of the ammeter to the other, the second ammeter may also be discarded.

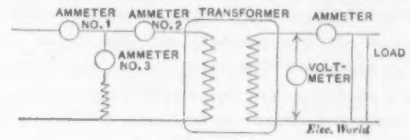



FIG. 8.

The same line of reasoning used with the voltmeter method will in this case give the formula,

$$W = \frac{V}{2v}(A^2 - A_1^2 - A_2^2)$$

Neither of these methods is of practical importance, as the readings differ greatly among themselves, while the time taken by the delicate instruments in coming to rest is considerable.

If it be required to measure the difference in phase between the primary and secondary currents it can be done by a method used by Dr. Ferraris.†

Three dynamometers are required. Through one the primary current is sent, through another the secondary, and the two currents combined through the third. If

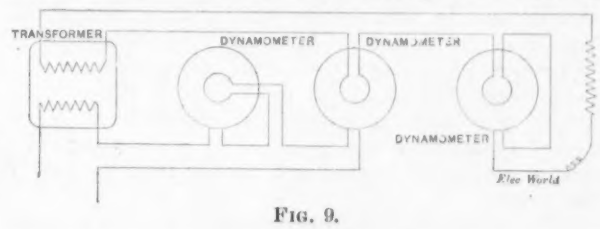



FIG. 9.

we call $x$, $y$ and $z$ the reading on the dynamometers, then, knowing the deflections to be proportional to the maximum current$^2$ multiplied by a constant, we have

$$x = h_1 A^2$$
$$y = h_2 B^2$$
$$z = h_3 A B \cos\varphi$$
$$\text{let } A^2 = a,\ B^2 = b,\ A B \cos\varphi = c.$$
$$\text{Then } \cos^2\varphi = \frac{c^2}{ab} = \left(\frac{c}{b}\right)^2 \div \frac{a}{b}$$
$$\cos\varphi = \frac{c}{b\sqrt{\frac{a}{b}}}$$

Thus giving the required lag. Transformers may also be conveniently tested by means of a wattmeter in the primary circuit as well as in the secondary, as this will give the efficiency directly.‡

## Very Curious.

A daily newspaper across the Atlantic thinks it is "a curious anomaly that at the very time that the application of electricity to all the purposes of civilization has shown such an extraordinary development the demand for steam engines has increased in almost the same proportion." It is equally curious that the demand for flour has increased in proportion to the demand for bread.—London "Electrician."

* See The Electrical World, Jan. 14, 1893.
† See Fleming, "Alternating Current Transformer," Vol. I., p. 305.
‡ See Fleming's "Cantor Lectures," Lond. "Elec. Eng.," Aug. 18 and 25, 1893.

# THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

## ELECTRO PHYSICS.

*Oscillations and the Aurora Borealis.*—The "Phil. Mag." for October contains an article by Prof. John Trowbridge "On the Oscillations of Lightning Discharges and of the Aurora Borealis"; the article does not admit of being abstracted, but the following extracts may be of interest: A lightning discharge appears to make way for its oscillations by first breaking down the resistance of the air by means of a disruptive pilot spark, and through the hole thus made in the air the subsequent surgings or oscillations take place; a lightning discharge is over in less than one hundred thousandth of a second; he finds the best method of photographing electric discharges is by means of a revolving mirror, instead of by moving the camera; he made a number of observations with this method, using an alternator and a step-up transformer together with a condenser; two very good photographs are given of discharges, showing 10 to 12 oscillations, the interval between each is about one hundred thousandth of a second; they show that the electric discharge follows exactly the same path in the air for three hundred-thousandths of a second. Regarding the aurora, he believes that the luminosity in a vacuum tube held in one hand while the other hand grasps the terminal of the transformer, closely resembles the phenomenon of the Northern lights; the stratified discharge in the aurora, he says, has no connection with the oscillatory discharge of electricity; the distances between the stratifications do not seem commensurate with the rate of alternation of the primary of the transformer; the distance between the stratifications is not dependent on the amount of self-induction in the circuit; he believes that the brush discharge is reduced to the case of one throb which is analogous to the pilot spark in the disruptive discharges; his experiments show that the waving and stratification observed in the aurora are due to the redistribution of the lines of force, which is produced by suitable earths or conductors in the shape of regions of cloud or moisture.

*Alternating Currents.*—The Lond. "Elec. Rev.," Oct. 6, contains a note by Mr. Whitwell, in which he compares the usual abbreviated with the full equation of the E. M. F. impressed on a circuit having self-induction, and shows that the effect of taking the third term into-account is apparently to increase the ohmic resistance by an amount inversely proportional to the square of the period, and that the effect of the fourth term is to apparently diminish the self-induction in a similar manner; the impedance is therefore diminished and the current increased, the lag being apparently diminished; the effect, then, of taking the fuller equation is to give a greater current and a less angle of lag.

*Interference Phenomena.*—The Lond. "Elec. Rev.," Oct. 6, reprints, with illustrations, a paper read by Mr. Barton at the recent B. A. meeting on "Electrical Interference Phenomena Somewhat Analogous to Newton's Rings, but Exhibited by Waves in Wires." The object is to make a quantitative examination of the reflections of the waves produced by wires placed in a circuit, which are thicker and thinner than the rest of the circuit.

*High Frequency Discharges.*—Mr. Swinton's paper in the "Phil. Mag." for September, mentioned in the Digest last week, is reprinted in "La Lum. Elec.," Sept. 30.

*Dielectrics.*—The "Phil. Mag." for October contains an abstract of a paper by Dr. Benische on some experimental investigations on dielectrics, from which he found, among other things, that the dielectric constant is independent of the strength of the electric field, and that there is no appreciable conductivity in the dielectric.

*Prof. Lodge's Electro-Magnetic Hypothesis.*—The article by Prof. Poynting, mentioned in the Digest last week, is continued in the Lond. "Elec.," Oct. 6, a number of diagrams being given.

*Theory of Electricity and Magnetism.*—Mr. Duponchel, in "Cosmos," Sept. 9, endeavors to explain, with the aid of illustrations, the actions of the molecules of electrified and magnetized bodies.

*Theory of Electrostatics.*—The "Jour. Telegraphique," Sept. 25, reprints an ar tic le from the "Ann. Telegraphiques," on the hypotheses on which the present mathematical theory of electrostatics is based.

*Electro-magnetic Theory of Light.*—"La Lum. Elec.," Sept. 30, contains another installment by Mr. Raveau on this subject.

*Propagation of Light in Metals.*—In "La Lum. Elec.," Oct. 7, Mr. Raveau publishes the first part of a mathematical article on this subject.

## MAGNETISM.

*Earth's Magnetism in Russia.*—"L'Elec.," Sept. 30, reprints an Academy paper on the recent magnetic observations in Russia by Mr. Venukoff; the magnetic elements were measured in Central Asia, and the local variations in European Russia; a table of the results is given. A very curious observation was made near Belgorod, where a variation sometimes as much as 180 degrees was noticed in a space only several tens of kilometres square, thus indicating a small magnetic pole, which is quite local; in other places variations in the declination were noticed up to 10 degrees in a distance of 21 kilometres.

*Commercial Magnetism.*—The continued editorial in "Ind. and Iron," Oct. 6, discusses the analogy between magnetic and electric circuits.

*Compensator for Hysteresis.*—The device mentioned in the Digest Oct. 7, under this heading, is described and illustrated more in detail in the "Elek. Zeit.," Sept. 29.

## UNITS, MEASUREMENTS AND INSTRUMENTS.

*Iron in Volt and Ammeters.*—Mr. Meylan in "L'Elec.," Sept. 30, discusses the subject of the effect of iron in volt and ammeters, giving the results of a series of tests made with a number of different forms of instruments; the principal objection to its use is due to hysteresis; to diminish this somewhat the important part of the graduation should correspond to relatively intense fields, which also makes the instrument more independent of exterior fields; in voltmeters one can either have all the resistance in the coil itself, or wind it with less resistance, thus decreasing heating, and adding a dead resistance of German silver; he prefers the latter. When once magnetized a piece of soft iron has a much less defined magnetization than if it is carried through a complete cycle, and such instruments should therefore be calibrated through the complete cycle. He tested a number of instruments taken from the best in the market, by increasing and decreasing the current very gradually—that is, without any sudden changes; with a solenoid drawing in an iron core he found that the difference between the mean and the ascending and descending value was several per cent., and was greatest for the lowest deflection; the errors will be at least 2.25 per cent. in the middle of the scale; the results will be more favorable if the counteracting force is increased—that is, if the magnetization is greater; such an apparatus is better suited for a voltmeter than for an ammeter, owing to the inaccurate reading at the beginning of the scale. With a voltmeter containing a pivoted iron disc opposed by gravity, the total deflection was only 55 degrees, which is a disadvantage of this form, which, on the other hand, is the best as regards hysteresis; the temperature error was 1.7 per cent; with this he obtained the best results, the error due to hysteresis being only one per cent. in the middle of the scale, but this becomes greater if the current is reduced to zero, and then reversed; the error at low readings was several per cent., but was below one per cent. over the greater part of the scale. With a voltmeter containing two pieces of iron which repel each other, very large deflections can be obtained up to 90 degrees; but this advantage is counterbalanced by greatly increased hysteresis; the maximum error due to heating was three per cent.; at the middle of the scale the error due to hysteresis was five per cent. His conclusions lead him to prefer the first two forms. The difference for alternating and direct currents is about three to seven per cent. for about 100 periods.

*Compensated Wattmeter.*—In measuring the watts consumed in an incandescent lamp by means of a wattmeter, either the current in the shunt coil is included in the current passing through the series coil, or else the shunt measures the potential of the lamp and the series coil combined; in either case there is therefore an error in the measurement; Mr. Ram, in his serial on incandescent lamps in the Lond. "Elec.," Oct. 6, describes the method suggested by Swinburne, by means of which this error may be compensated completely; a second coil is wound over the series coil and with as many turns as the series coil itself; this additional coil is connected in series with the voltmeter coil, but so that the current flows in the opposite direction to that in the series coil; by this means the effect of the shunt coil current flowing through the main series coil is neutralized by this compensating coil; the wattmeter will thus give a correct reading of the power consumed in the lamp. A diagram of a wattmeter having two main series coils and two compensating coils, for obtaining two different constants, is given. In the same article the Evershed ammeter is described and illustrated, it being compensated in the same way.

*Sensitive Ballistic Galvanometer.*—The Lond. "Elec.," Oct. 6, describes the galvanometer used for physiological purposes, described by Dr. Lodge at the recent B. A. meeting. The object is to obtain great sensitiveness; the sensitiveness is claimed to be twice as great as that of the usual galvanometers of the same resistance; Lord Rayleigh has shown that a pointer read by a microscope admits of just the same degree of accuracy as the mirror method; Dr. Lodge therefore suggests using a bee-sting as a pointer in connection with the micrometer eyepiece of a microscope, thus avoiding the weight of the mirror.

*The Hefner Standard Lamp.*—The Lond. "Elec.," Oct. 6, reprints an abstract from the "Zeit. fuer Instrumentenkunde," No. 7, 1893, describing in detail this standard lamp. The unit is defined as "the illuminating power which is possessed by a flame rising from a massive wick saturated with amyl acetate, and burning freely in pure, still air. The wick is to completely fill a German silver tube of 8 millimetres inner and 8.3 millimetres outer diameter, and 25 millimetres clear length, and the flame shall be 40 millimetres high from the summit of the tube, measured not less than 10 minutes after lighting the lamp." Researches made at the Reichsanstalt gave very favorable results; they showed that very considerable accuracy was unnecessary for the above dimensions, excepting only the thickness of the sides of the wick tube, the illuminating power being diminished if the tube is too thick, while if too thin the flame is not steady; a great degree of purity is necessary in the amyl acetate, and simple means can be applied to detect excessive impurity; the acetate is not affected by keeping; the lamp must be properly ventilated, as the pressure of the carbon dioxide has a very appreciable effect in diminishing the light; the variations due to meteorological conditions are not large enough to affect practical work; every lamp must have a flame measurer for determining the height of the flame. The English standard candle used in Germany with a flame 45 millimetres high gives a mean value of 1.41 Hefner units, and the German Union paraffine candle, with a flame of 50 millimetres, gives a mean of 1.2 Hefner units.

*Thermo-electric Currents in Measuring Instruments.*—Mr. Strecker, in the "Elek. Zeit.," Oct. 6, calls attention to the fact that binding posts and other portions of galvanometers, which it is necessary to touch with the fingers, as also sliding wire contacts, are made of a different metal than the wires connected to them, thus generating thermo-electric currents, which cause errors in the measurements; this mistake is made even by the best instrument makers; there is no apparent reason why they should not be made of the same metal.

*Testing Switch.*—The Lond. "Elec.," Oct. 6, describes and illustrates very fully the Hill switch, for use more particularly on board cable repairing steamers; it gives instantly by simply moving a lever the combinations for the four tests constantly in use, and its fifth position leaves the instrument disconnected.

*Cupric Nitrate in a Voltameter.*—Attention is called to an interesting article by Mr. Beach in the "American Journal of Science" for August, in which he points out the advantages of using nitrate instead of sulphate of copper.

*Measurement of Power in Three-phase Circuits.*—In a short mathematical note by Dr. Froelich in the "Elek. Zeit.," Oct. 6, he shows that the power can be measured by inserting an ordinary wattmeter in each of the three circuits, or by using one instrument with three fixed and three movable coils, the latter being connected to a common axis. In a subsequent article he intends to give the advantages and properties of this method.

*Batault Meter.*—"L'Ind. Elec.," Sept. 25, gives an illustrated description of this meter; a pendulum is operated by the well known Hipp's movement, only when a current is being used; every minute this pendulum measures and records on dials, a linear distance as determined by an ammeter, which is said to be strictly proportional to the current.

*Routin Meter.*—The Lond. "Elec. Eng.," Oct. 6, reprints from the French the illustrated description of this meter, mentioned in the Digest last week.

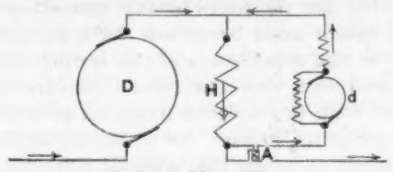
*Duncan Wattmeters.*—"La Lum. Elec.," Oct. 7, gives a well illustrated description of these wattmeters for both simple and three-phase systems.

## DYNAMOS AND MOTORS.

*Direct Calculation of Field Magnets.*—Mr. Bary, in "L'Ind. Elec.," Sept. 25, describes a comparatively simple method by means of which the size of wire and the winding of a field magnet may be calculated directly without any trial calculations; the final equation for the diameter of the wire is somewhat complicated, and is in French units, for which reason it need not be given here, but a method of arriving at it is briefly as follows: The current and voltage for the field magnets are given by the per cent. of the output which is to be devoted to it; from this the resistance is determined; the amount of flux determines the cross-section, and therefore the periphery of the magnet cores; the length of the coil is determined from the periphery and from the constant, 15 watts per square centimetre radiating surface; the total number of turns is calculated on the Hopkinson method, after having determined the dimensions of the magnetic circuit; the length of the coils should, however, be calculated first, as the calculation of the number of ampere turns depends on this length; from geometrical relations, including an allowance for the insulation of the wire in the form of a constant, he obtains the final formula for the diameter of the wire, after having substituted in it the mean length of one turn, and the resistance in terms of the mean length and the cross-section (the final equation is a quadratic, and it is a question whether its application would be simpler than several trial calculations); the formula is given for magnets of a rectangular and of a circular section (either of which is seldom used).

*Series Motors.*—Mr. Mariotti, in the "Elek. Zeit.," Sept. 29, calls attention to the advantages of series over shunt and compound motors in constant potential circuits, and describes a method by which they can be used even with variable loads. The arrangement is

shown in the adjoining cut in which *H* is the series winding of the large motor *D*, and *d* is a small compound dynamo driven by the motor and connected as shown; the main current will be proportional to the power consumed, and the current delivered by the small dynamo will vary inversely as the power—that is, at no load the small dynamo will give its maximum current, while at full load its current will be zero; the speed of the motor at constant load depends on the magnetism; for variable loads at constant speeds the magnetism must be varied—that is, the dynamo must be so calculated that the field current is always the proper amount; he describes, with the aid of characteristic curves, how the small dynamo must act; the efficiency of the small dynamo is of no importance, as it runs without a load when the work is a maximum, and its failure to act would in any case simply leave the other a simple series motor; in a 14-h. p. motor, running with 500 volts, he used a 400-watt dynamo, and found the variation in speed between one and 14 h. p. was only four per cent., which, he thinks, could be reduced, if the small dynamo had been calculated for that purpose.



SERIES MOTORS.

*Self-exciting Armatures.*—The Lond. "Elec. Rev.," Oct. 6, publishes an abstract of Mr. Sayers' paper, mentioned in the Digest last week, together with two cuts; the object of the machine is to compensate for differences in the voltages due to the current in the neutral wire of a three-wire system; in an extreme case in which the current on one side is double that on the other, and with a cross-section of the neutral wire equal to one-half of that of either of the others, he shows that there will be a fall of 10 volts, both in the feeder and in the neutral wire, as regards the overloaded side, but this counts as a rise of 10 volts, as regards the underloaded side, and as the fall in the feeder on that side is only five volts, the fall in the feeder on the underloaded side must give only 95 volts in order that the voltage at the distant ends shall be 100, while the voltage on the overloaded sides must give 120 volts; this disturbance is compensated for in his compensating dynamo by a winding connected in series with a neutral wire, which is put on in such a way as to modify the amount of pressure added to or subtracted from the two sides of the system.

*Alternate Current Motors.*—Mr. Huber, of the Oerlikon Company, in a communication to the Lond. "Elec.," Oct. 6, states that recent tests made with a 9 and 12-h. p. motor of not quite the same design, showed that the starting current in both was equivalent to 15 h. p.

*Non-synchronous Motors.*—Mr. Farman, in the "Bul. de l'Assoc. Montefiore," for August, gives a theoretical discussion of non-synchronous motors, his conclusions being that the starting torque is very small, that it increases with the velocity, and that the motor tends to maintain a certain velocity.

TRANSFORMERS

*Adjustable Transformer.*—The "Elek. Zeit.," Sept. 29, describes briefly a transformer intended specially for cauterizing; its capacity is 150 watts, and it will give 14 different voltages between 0 and 5 volts.

*Closed Circuit Transformer.*—Mr. Tanner, in "L'Ind. Elec.," Sept. 25, shows that a transformer with an almost closed magnetic circuit was invented by a Frenchman in 1857, and described in his patent; this, he says, shows a knowledge of the advantages of a closed iron circuit.

ARC AND INCANDESCENT LIGHTS.

*Researches with Alternating Current Arcs.*—Mr. Blondel's long serial, mentioned in the Digest Oct. 14, is concluded in "La Lum. Elec.," Sept. 30. An abstract of this article was given by Mr. Blondel in the form of a paper presented at the Chicago Congress. Among the conclusions to which his researches lead him the following may be of interest. To distribute light economically the following conditions should be complied with: The loss in the carbon should be as small as possible; the loss in the lamps, wires and machines should be made as small as possible by increasing as much as possible the power factor of the circuit and of the arc; by increasing as much as possible the light efficiency of the arc. The first condition is easily realized by making the carbon dense, and the cross-section of the core relatively small; the second, by the use of soft cores in the carbons, the result of which is to reduce the self-induction and the dead resistance necessary for stability and to make the arc more like a simple, non-inductive resistance; the third condition involves two contrary elements, the self-induction being advantageous for reducing the extinction of the light, and therefore the lowering of the degree of incandescence, while, on the other hand, soft cores diminish the brightness of the incandescent parts by at least 15 to 20 per cent., and give the light a red color; he thinks that constructors sacrifice light to stability. He states that the phenomena of the alternating arc is more complex than is generally believed; that the different effects produced by different machines is due to their different resistance and self-induction; the form of the curve depends on the composition of the circuit and on the nature of the carbon, more especially on the core; the extinction of the arc at every alternation is not always accompanied by a cessation of the current, which latter disappears the more easily as the circuit is more inductive and the core more conductive, and it is very long in hissing arcs in non-inductive circuits. His researches lead him to believe that there is no counter electromotive force or polarization, strictly speaking, in the arc; the power factor of the arc approaches unity the more silent the arc and the softer the core; it approaches 95 per cent., in which case, the arc may be regarded as a dead resistance, but with homogeneous carbons and hissing arcs, it may be as low as 70 per cent. between 26 and 52 periods; the stability of the arc depends on the nature of the carbons, on their core and on the electromotive force, which should not be confounded with the voltage at the binding posts; the stability increases with the frequency and with the self-induction; the use of arcs in series is highly recommended, but should not involve the use of too low voltages, as well conducting cores transform the arc into a sort of semi-incandescent lamp, whose stability and power factor are very good, but whose luminous efficiency is poor; he believes that it is not well to put more than three lamps in series in 110 to 120 volt circuits, leaving 32 to 25 volts at the extremities of the carbons; the rest of the voltage should be absorbed in self-induction coils; one thereby obtains a good stability without sacrificing the luminous efficiency or reducing the power factor too much.

*Alternating Arcs Depending on the Form of the Curve.*—In a previous article (see Digest, Sept. 23), Mr. Sznapiro showed that the same effective alternating voltage will produce different currents depending on the form of the wave; in a subsequent article in the "Elek. Zeit.," Sept. 29, he shows how this will effect arc lamps; he states that if the lamp is adjusted for a sine current and is then used with a current differing from a true sine current, the lamp regulator will lag behind in its regulation; it will regulate badly, and may even refuse to burn at the voltage for which it is adjusted; if adjusted to regulate at 28.5 volts, it may not regulate below 30 or 33 volts, that is the difference between the squares of the currents in the shunt coil may amount to 10 or 15 per cent.; he concludes, therefore, that such lamps should always be adjusted with the machine with which they are to be used. With homogeneous carbons and with hissing arcs there wil be considerable shifting of the phase between the current and the voltage, and a consequent altering in the wave form, even if the dynamo generates a sine E. M. F. He states the general law that the same effective voltage at the ends of a circuit containing resistance and self-induction will generate a smaller current the greater the voltage differs from a true sine curve; he adds that hysteresis would probably increase this difference.

*Arc Lamps.*—In the Lond. "Elec. Rev.," Oct. 6, Mr Rankin Kennedy begins a serial entitled "The Scientific Study of Arc Lamps," in which he intends to confine himself "to the essential things in an arc lamp, and illustrate the combinations by a few well known successful ones." In his opinion "the arc lamp is only beginning to be understood by those who have been in the arc lamp business, and those outside of that business have only a very superficial knowledge of the subject." The present portion is quite elementary and contains nothing new.

*Arc Lighting.*—In the Lond. "Elec. Rev.," Oct. 6, Mr. Carter describes and illustrates the Phoenix dynamo for arc lighting, which, he says, is one of the best known among the closed armature coil types.

*Arc Lamp.*—An arc lamp whose chief qualities seem to be a robust and simple construction is described in "L'Elec.," Sept. 30.

*Lighthouse Light.*—The Lond. "Elec. Eng.," Oct. 6, gives some information about the new Cap de la Heve lighthouse, which is 30 to 40 million c. p., and which is said to be the most powerful lighthouse in the world; both direct and alterating currents are used, but how, is not stated; in order to produce rapid flashes, the revolving panels are placed on a float in a mercury bath, thus diminishing the friction and allowing it to make a complete revolution every 20 seconds, while in ordinary lighthouses at least four minutes are required.

*Forcing Incandescent Lamps.*—The Lond. "Elec. Eng.," Oct. 6, publishes several tables and diagrams, intended to show how far the forcing of lamps is justified in view of the recent reduction in the price of lamps in England; the figures show that the saving in using a 40-watt instead of a 60-watt lamp is greatest where the current is expensive; it is 8, 9, 10 and 11 per cent. when the price per kilowatt-hour is 10, 12, 14 and 16 cents, respectively; as regards 8-c. p. lamps, the price is still too high to give any material economy in forcing when current is cheap, the total cost of 20-watt lamps, including renewals, being more than that of the 25-watt lamps; in proportion as the cost of the current diminishes the economy of reducing the watts per lamp is also less; although, therefore, considerable saving is effected by forcing 16-c. p. lamps, this does not necessarily apply to lamps of smaller candle powers.

*Repairing Incandescent Lamps.*—The "Elek. Anz.," Sept. 24, describes and illustrates two processes used commercially in Germany. One of them consists in cutting off the bulb a short distance above the base, replacing the filament, and fusing the glass together again. The other consists in making an opening at the top of the lamp sufficiently large for introducing a new filament; by heating the bulb, the carbon deposit is removed; on the ends of the leading-in wires small lumps of cement are placed, made of graphite, boric acid and gum (gum arabic?); the ends of the new filament are secured to these by pressure, and when dry a copper wire, with a small carbon rod at the end, is connected to the circuit and introduced through the opening, the other end of the circuit being connected to the leading-in wires; on touching this carbon rod to the joint, an arc is produced, which brings the cement to incandescence, making it a conductor; both processes can be repeated any number of times, and the cost of renewal is said to be less than the cost of a new lamp.

*Incandescent Lamp.*—"Ind. and Iron," Oct. 6, publishes an interview with Major Page, of the Edison & Swan Company, England, regarding the effect of the expiration of Edison's fundamental patent in England. There is also an editorial on the same subject.

*Incandescent Lamp Manufacture.*—In Mr. Ram's serial in the Lond. "Elec.," Oct. 6, he discusses the subject of wattmeters and ammeters used for lamp testing, two instruments being illustrated. (See above under Compensated Wattmeter.)

The "Elek. Anz.," Sept. 28, continues its serial on this subject, the present issue containing a number of cuts of the apparatus used.

TRANSMISSION OF POWER.

*Rome Transmission Plant.*—"La Lum. Elec.," Oct. 7, publishes the first part of a well illustrated description of the transmission from Tivoli to Rome, an installation which has already been described in many electrical journals; some of the cuts appear to be new and interesting.

*Power Transmission Systems.*—The Lond. "Elec. Eng., Oct. 6, reprints a paper by Mr. Allen, in which he discusses briefly, and in a rather elementary way, the different systems, most of them being mechanical, but without giving any conclusions or anything new.

*Transmission of Power.*—Prof. Unwin's first lecture is concluded in the Lond. "Elec. Eng.," Oct. 6.

ELECTRIC RAILWAYS.

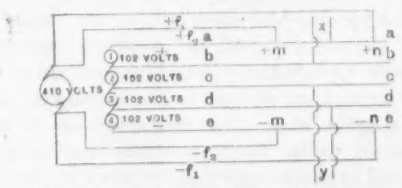
*Brussels Underground Railway.*—"La Lum. Elec.," Sept. 30, gives quite a fully illustrated description of this proposed railway, already mentioned in the Digest Sept. 23, also in The Electrical World, Sept. 2, page 183.

*Railway Return Leads.*—"La Lum. Elec.," Oct. 7, contains a cut of the Churchill system mentioned in the Digest last week.

*Stanserhorn Mountain Road.*—The "Zeit. fuer Elek.," Oct. 1, describes this new Swiss mountain railroad, which is operated electrically.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

*Manchester Five-Wire System.*—The Lond. "Elec.," Oct. 6, gives a fully illustrated description, including plant and elevations of this new station. It is of special interest, as it is the first installation in England in which the five-wire system is used, and also because it was designed by Dr. J. Hopkinson. The general arrangement of the system is shown in the adjoining cut; the generating dynamos are run at 410 volts, the current being led by several pairs of feeders to eight points on the outside mains of the five-wire system; lamp connections are branched off from the main connections as at *X* and *Y;* the mains are led back to the station where they are connected to the four compensating dynamos, each of which is said to be driven by a separate engine; the voltage is regulated by varying the speed of the engine, which is done by governors on the cut-off valves; instead of connecting all the generators to common bus bars, the switch arrangements are made so that any one or several pairs of feeders may be coupled to any dynamo; instead of using pressure wires to indicate the voltage at the ends of a feeder, he relies on the ammeters, and regulates each engine to give the necessary voltage for that particular current (but different currents in different feeders connected to the same generator would require different voltages). For more than 80 amperes in a building the wires are connected to two sections, for more than 160 amperes to three sections, and so on; the consumer may elect to pay either 16 cents per kilowatt-hour, or about $15 per quarter per kilowatt demanded, plus 4 cents per unit actually consumed, this system being the well known one devised by him.



MANCHESTER FIVE-WIRE SYSTEM.

The description of the plant is interesting, and is recommended to designers of central stations.

*Three-Phase Installation at Erding (Bavaria).*—The "Elek. Zeit.," Sept. 29, gives a detailed and well illustrated description of this station, which is considered as a typical installation of its kind. Two three-phase generators of 40 kw. each generate a current of 1,500 volts at a frequency of 100, which is transformed down to 100 volts at various points in the city; the dynamos are connected in parallel, even though they are driven from the same shaft, by means of independent belts; the high tension circuit consists of bare wires; during the daytime the current is sold at a greatly reduced rate, and it is believed that the consumption during the daytime will therefore soon be equal to that at night; it has been found that even with very unequal loads on the three circuits, the variation in the voltages of the three circuits is so slight that in practice it can be neglected.

*Three-Phase Apparatus.*—The "Elek. Echo," Sept. 23 and 30, publishes a descriptive article of a three-phase apparatus as made by the firm of Siemens & Halske; the article includes 23 cuts, showing the apparatus, diagrams of installations, switchboards, etc.

*Train Lighting.*—"La Lum. Elec.," Oct. 7, describes the system used for two years in Italy; it appears to be quite similar to that used on the Jura-Simplon line already described in these columns.

*Stage Light Regulator.*—The "Zeit. fuer Elek.," Sept. 15, gives an illustrated description of a new regulator for stage lights, made by the firm of Schuckert & Co.

*Helsingborg.*—The "Elek. Zeit.," Oct. 6, publishes a detailed, fully illustrated description of this Swedish station; the continuous current, three-wire system is used, with three large dynamos, thus requiring two to be run continuously for all loads, large or small, the third being simply as a reserve; there is nothing of particular interest about this station, except that it would have been much more successful if accumulators had been used.

*Vincennes.*—"L'Ind. Elec.," Sept. 25, describes briefly the small station in this town, a feature of which is an automatic switch for connecting and disconnecting continuous current dynamos in parallel.

*Bradford.*—The Lond. "Elec. Eng.," Oct. 6, publishes the accounts for this station up to June 30 of this year.

*Edinburgh.*—"Ind. and Iron," Oct. 6, describes very briefly some features of Prof. Kennedy's station in Edinburgh.

*Envermea.*—"La Lum. Elec.," Oct. 7, publishes a short description of the installation in this French town; there appears to be nothing of special interest in it.

*Seger Steam Turbine.*—"La Lum. Elec.," Oct. 7, gives a short illustrated description of this steam turbine, in which the steam passes only through a small portion of two turbine plates, one behind the other, both of which are geared to a common shaft.

*Gas Engine.*—Mr. Hoerst, "Bul. de l'Assoc. Montefiore" for August, gives the results of some tests with gas engines, showing that when running without a load a 25-h. p. engine consumes six-tenths of the amount of gas that it does at 27.8 h. p.; in another case the consumption at 2.7 h. p. was three-fourths of that at 17 h. p.; this shows the advantage of combining accumulators with gas engines when used for electric lighting, as the engines may then be kept loaded fully all the time.

"L'Elec.," Sept. 30, reprints at some length a paper by Mr. Dowson read at the recent Congress of the Incorporated Gas Institute of London.

*Three Cylinder Gas Engine.*—The Lond. "Elec. Rev.," Oct. 6, describes and illustrates a new three-cylinder gas engine just brought out in England.

WIRES, WIRING AND CONDUITS.

*Stranded Cables.*—Mr. Everett, in the Lond. "Elec. Eng.," Oct. 6, shows that for a given cross-sectional area of copper the diameter of a stranded cable becomes greater as the number of strands are increased; supposing the circular space inside the insulation of an insulated stranded cable to be fixed, he finds the ratio of the cross-sectional area of copper to the area of this variable circular space to be as follows: For 1 strand, it is 1; for 7 strands, it is .778; for 19, it is .760; for 37, it is .775; for 61, it is .753; and for 91, it is .752; for an infinite number of strands, it would be .750.

*Bi-metallic Wires.*—The "Zeit. fuer Elek.," Oct. 1, describes and illustrates the Martin process used in France for making wires of a core of steel or iron and a coating of copper in order to obtain both strength and conductivity.

TELEGRAPHY, TELEPHONY AND SIGNALS.

*Effect of a Grounded Neutral on Telephone Circuits.*—Mr. von Gaisberg, in the "Elek. Zeit.," Oct. 6, refers to the recent tests of Mr. Grawinkle (see Digest, Oct. 14), and states that the system in Hamburg is a simple two-wire system, and that the results in the two cities can therefore not be compared with each other.

*Electric Distribution of Time.*—The Lond. "Elec. Eng.," Oct. 6, describes briefly a new system recently brought out in Geneva.

*Italian Telegraph Statistics.*—The "Jour. Telegraphique," Sept. 25, gives the telegraph statistics for Italy for the years of 1891-92.

*Telegraphic System for Fortresses.*—The "Elek. Echo," Sept. 30, publishes an article on this subject by Mr. Nistler.

ELECTRO-CHEMISTRY.

*Manufacture of Chlorates.*—Mr. Blount, in the Lond. "Elec. Plant," for October, describes briefly the Gall and Moutlaur process used in France; potassium chloride is electrolyzed at a current density of 50 amperes per square decimetre, the bath being heated, and the hydrogen which is formed being mechanically excluded from the products appearing at the anode, by means of an ordinary porous partition; the anodes are made of platinum-iridium. The second process described is that of Messrs. Gibbs and Frauchot; the hydrogen is in this case removed by using a cathode consisting of copper oxide, thus forming metallic copper and obviating the use of a porous partition; the heat set free in the reduction of the copper is sufficient for heating the bath.

*Qualitative Analysis by Electrolysis.*—The Lond. "Elec.," Oct. 6, reprints a paper by Dr. Kohn read at the recent B. A. meeting, in which he examines the applicability of electrolytic methods to the detection of mineral poisons, such as antimony, mercury, lead, copper and cadmium; regarding arsenic, he states that Wolff has succeeded in detecting .00001 gram of arsenious acid by means of electrolysis.

MISCELLANEOUS.

*Resistance of the Human Body.*—In an article by Mr. Horweg, in the "Weckblad," of July 22, abstracted in the Lond. "Elec. Rev.," Oct. 6, he discusses the subject of whether the human body possesses different resistances for different induction shocks, or in other words, whether the resistance is a function of the E. M. F.; he finds it to be the case in the human body, as also with wet paper, with a carbon rheostat, and with a faulty contact between a wire and a screw; he believes that there is only one explanation possible, and that is, that the body possesses a great capacity and it will therefore act under induction shocks differently from ordinary metal wires; it cannot, however, be compared with a condenser, but it is more like a submarine cable, which possesses great capacity and at the same time transmits current; he substantiates his conclusions by giving the results of a number of tests.

*Lightning Induction Discharges.*—"Ind. and Iron," Oct. 6, records a curious case in which a table in a house was apparently set on fire by lightning, although the lightning itself did not strike the house; the explanation offered is that sparks from induced currents passed between the fine metallic threads which were woven into the fluffy material of cotton and wool used for ornamenting the table, the sparks are supposed to have set the cotton on fire.

*Chicago Congress.*—"L'Ind. Elec.," Sept. 25, is an article on this subject, calls attention to the fact that there was an almost absolute absence of any organization, and that the report of the Chamber of Delegates read at the closing session contained important errors. The same number contains a summary of the principal papers which were read.

*Exhibition of 1900.*—"L'Elec.," Sept. 30, gives further data regarding the Paris Exhibition of 1900.

## A New Fibrous Insulation and Its Bearing on Underground Telegraph Lines.

BY CHAS. CUTTRISS.

Among the various electrical industries which of late years have reached enormous proportions due to the remarkable advancement in electrical science not the least in importance is the manufacture of insulated wire.

Insulated wires may be very properly divided into two classes:

First, those that depend upon the insulating coating of elastic gums, such as india-rubber in any of its many forms of manufacture, or gutta percha.

Second, those that depend upon a covering of fibre (such as a yarn of any kind) to keep the wire central, which is afterward saturated with some of the many insulating materials and protected from moisture by an outer sheath of metal, upon the integrity of which the insulation of the wire depends. Each of these classes have their special fields of usefulness: India-rubber and gutta percha insulated wires are used for submarine cables, or, when a metal protection is applied, they are always used for underground and interior construction. The fibre insulation when protected with a metal covering or sheath is generally used for underground work, but large quantities are used in the overhead construction of telegraph and other circuits without the metal covering. During my experience with telegraph circuits, it has often occurred to me that a wire embracing in part the qualities of an india-rubber or gutta percha insulation with the cheapness of a fibre-covered wire was a great desideratum, and I saw no reason why such a wire should not be produced. To this end, I, in connection with Mr. A. A. Knudson, have worked for the last two years and it can be confidently stated that this new wire, manufactured under our patents by the Phillips Insulated Wire Company, of Pawtucket, R. I., and just being placed on the market under the cognomen of "Ideal," will find a great field of usefulness as being infinitely superior to any of the existing fibre insulations and in some ways better than the india-rubber or gutta percha.

One trouble incident to the use of bunched cables, as they are termed, or cables consisting of many fibre insulated wires contained in one metallic sheath, is the fact that any mechanical damage to the sheath means the loss of many, if not all, of the wires, as the moisture from the ground or conduit in a few hours will so penetrate the cable that the wires become crossed or grounded to such an extent as to be useless for telegraph circuits. It was one or two experiences of this nature that spurred me on to produce a wire that would combine the cheapness of fibre with the moisture resisting properties of india-rubber or gutta percha. In order to do this, it became necessary to make the layer of fibre as nearly as practicable homogeneous, and for this purpose all yarns or manufactured fibres had to be discarded. Experiments were then begun on raw fibres of different kinds and ultimately cotton in the form of a saliva as it comes from the cotton gin was found to give the best results. The precise methods of manufacture cannot, of course, be detailed, but it is sufficient to state that the wire is so covered with this saliva that before saturation with the insulating material it is so densely compacted round the wire that considerable pressure is necessary to make an indentation. After this covering with cotton, the wire is placed in tanks of insulating material and remains there until thoroughly impregnated; it is then drawn out and wiped off. For making bunched cables and many other purposes, no further treatment is necessary, but where exposed to abrasion a braid can be applied and the exterior finished in any of the well known ways. The insulating material is of such a nature that all the ingredients are chemically combined for the reason that the fibres being so densely compacted they act as a filter, and if the insulating compound contained any material that was only held mechanically in suspension, the suspended matter would collect on the surface and only the thin or liquid part of the insulating material would penetrate to the wire and not give it the dense and horn-like character that is the principal moisture resisting quality. When an ordinary fibre-covered wire is bent round a small cylinder and the insulation cut so as to show the part near the wire or under the braid, an examination with a magnifying glass will show that the spaces between the yarns have become opened so that the insulating material fails to bridge the spaces, whereas in the "Ideal" wire, a No. 14 copper wire can be bent round a lead pencil without any opening being discernible, in fact, when the fibre is cut with a sharp knife it shows a clean, bright, dense shaving. If the ends of the wire are left in water for weeks, the moisture does not creep back, and when wiped off and retrimmed it is in perfect condition for jointing. The tests for insulation on wire of this kind give surprising results. Samples of 10 and 20 feet have been immersed in water for two and three weeks without breaking down, showing that a cable composed of this wire would remain intact after the lead protection had been injured for such a length of time that repairs could be effected to the injured spot without the loss of any other wires than those mechanically injured in the first case. This feature in a fibre-covered wire for underground construction is invaluable, and for overhead construction it is a very strong point in its favor, as I have not yet succeeded in breaking down the insulation by the repeated wetting and drying of two wires which have been twisted together. Hence, for passing through trees and similar places the continuance of a wet spell cannot injure the insulation of the line; at the same time the hard, horn-like character of the insulation is a great protection against abrasion.

The question of connecting cities by underground telegraph circuits has long been a mooted point, and it is a fact that lately some of the principal railway corporations have been investigating the feasibility of connecting cities to which they run by cables laid in or on the roadbed of their system, and if it were not for the high cost of india-rubber and the weak points of the ordinary fibre-covered wires it is possible that a cable system might have been adopted and permanent communication between cities assured, or what is of greater importance to them the integrity of their block system maintained. Cables can now be made of "Ideal" wire at a cost slightly exceeding the ordinary fibre insulations, the integrity of which can be guaranteed; any damage, mechanical or otherwise, will be confined to the cores directly receiving it. Arguments have been made against the impracticability of working underground cables of such length at a speed sufficiently high to insure the commercial success of the undertaking. In reply to these arguments I will make the assertion based on 20 years' experience of the practical working of Atlantic cables, that underground cables can be constructed 100 to 300 miles in length, over which working speeds of 550 and 250 words per minute respectively can be maintained by means of apparatus which is in constant daily use, and if such lengths of cables were laid and experimented with, I am confident that in a very short time the speed would be greatly increased. These figures, I think, will not be found much below the practical speed of land lines of equal length.

One great point to be borne in mind is that the underground circuits are clear from all foreign interference, such as leaks, swings and crosses, which, more than anything else, tend to reduce the average speed of Morse working on land lines to a comparatively low figure and raise the number of errors to a high one.

## Marine Type Multi-Cylinder Engines.

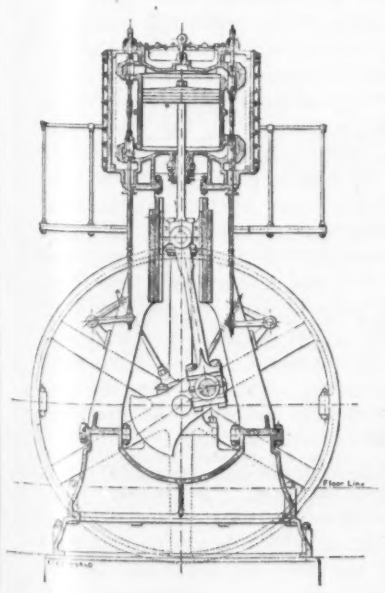
The struggle in marine practice between the simple and multi-cylinder expansion types of engine had been fought, and the victory won by the latter, almost 20 years before the great advances that resulted in marine practice seemed to have any effect on builders of land engines. It is but a few years ago that crudely designed compound land engines were regarded as triumphs by those unacquainted with marine practice, and it is even more recently that the conservative land engineering element, with their prejudice against multiple expansion engines, have been relegated to the rear, as their marine brethren were more than a generation ago. The rapid advances that have recently been made in land steam engineering practice have been almost entirely due to the progressive spirit of the young men so largely enlisted in the electrical industries, and their adoption of the vertical marine type of engine has largely cleared the way for the great progress most recently made.

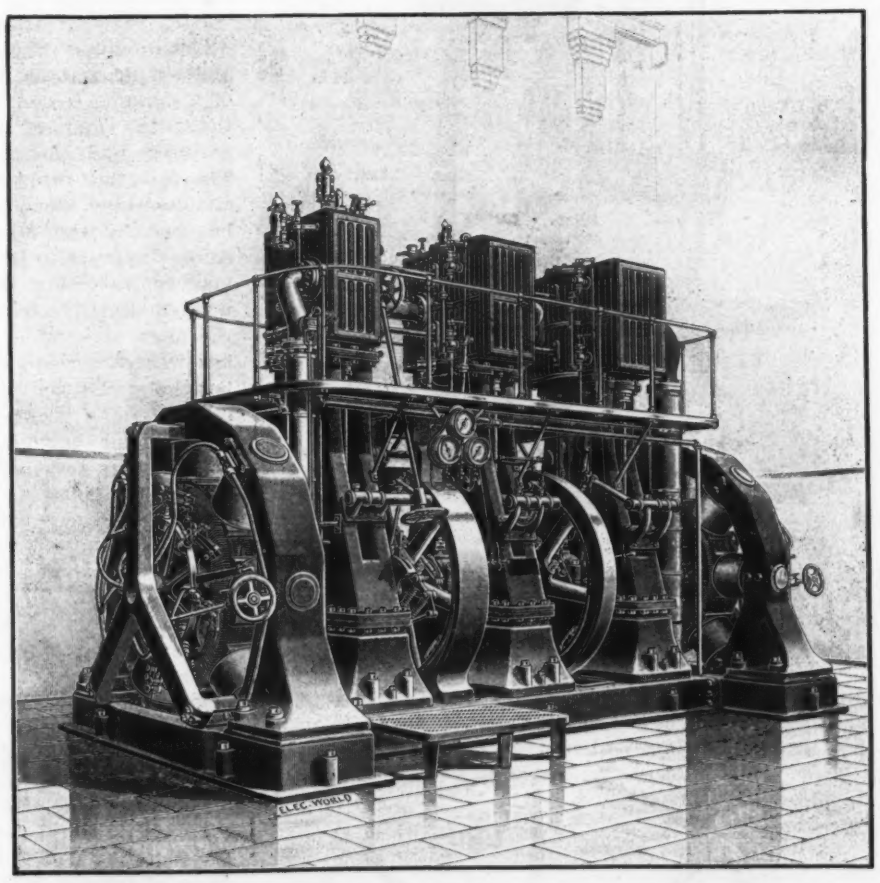
We have lately described in these columns several marine type engines for electrical service, and we illustrate herewith a vertical three-cylinder triple expansion condensing engine which is one of several similar types manufactured by the Lake Erie Engineering Works, for which the Field Engineering Company, 143 Liberty street, New York City, is the selling agent.

The cut in section shows the working parts; the cylinders are of the four-valve type with separate ports for admission and exhaust. The valves are of the double-faced slide type and are small, light and four-ported; the high pressure steam valve is wholly balanced, and the others, working under light pressures, are operated by independent gear. The lap is adjustable, permitting of the most advantageous setting for either condensing or non-condensing service. The governor and steam valves are constructed so as to carry the steam so far as three-fourths stroke in the first cylinder, should the demands of the load at any time require it, thus permitting the engine to exert much more power under these conditions than usual. This feature specially qualifies the engine for railway and other work subject to occasional overloads.

The movement of the high-pressure admission valve is controlled by a centrifugal shaft governor, by means of which the engine is regulated as regards the speed of revolution. The governor, which is located between the high and low pressure cylinders, has only two weights, one spring and four pivoted joints, and is very sensitive.

Special attention has been given to the design of the main bearings, which are so proportioned that the pressures thereon, and the velocity of their rubbing surfaces, are within limits admitting of great durability and ease of management. On account of the severe service to which electric railway engines especially are subjected, and in order to provide for emergencies, all bearings are water-jacketed and removable. The slides are also water-jacketed and are arranged so they can be easily removed and renewed in case of accident. The cylinders are neatly lagged with iron, and the intervening spaces between the cylinders and lagging filled with a non-conducting material. The steam chest covers are provided with paneled or corrugated hoods, polished on the exterior surface.



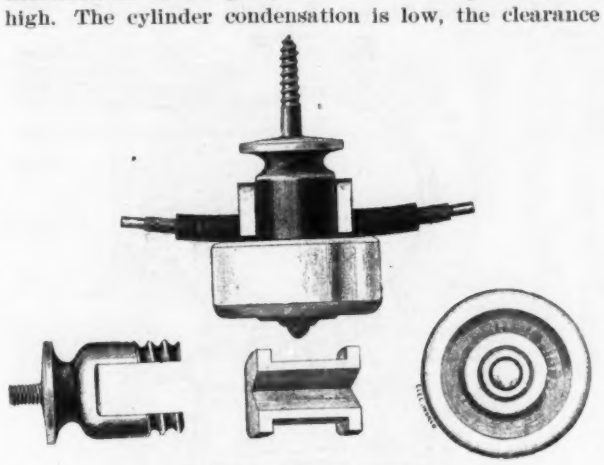


MARINE TYPE TRIPLE EXPANSION ENGINE.

The frames supporting the cylinders are of the "A" type of double box columns of cast iron bolted to flanges on the bottom of the cylinder and the bedplate. The slides are on the inner surfaces of the columns.

Much care is shown in the construction of the details of the engine. The pistons are of the best marine type, and the piston rod and cross head are of steel and forged in one piece; the cross-head slippers are adjustable by liners, and the connecting rod is forged and of the forked pattern, with wrist pins secured firmly to the ends of the fork, having a central bearing in the cross head. The crank end has a two-part box, independent of the rod forging, with through bolts. The crank shaft is of forged steel, of built-up pattern, with counterbalances in one piece. The throttle valve is located in the high-pressure steam chest, and is provided with hand wheels for operating from floor and platform. The engine is provided with suitable substantial iron galleries, stairs, hand rails and posts, as shown.

As regards economy, it can be readily seen, from the steam distribution effected by means of the valve gear described on this engine, that the economy should be high. The cylinder condensation is low, the clearance small and the steam distribution through the cylinders good.



A NEW INSULATOR.

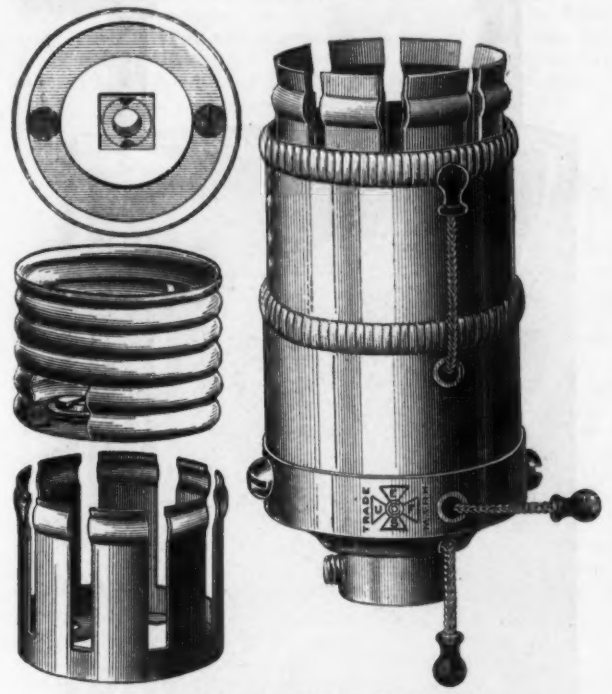
The three cylinders of the engines illustrated are 10 inches, 16 inches and 25 inches in diameter, respectively, with a stroke of 20 inches. The piston speed is 617 feet per minute, with 185 revolutions. The high and intermediate cylinders are jacketed with full boiler pressure, the low-pressure being unjacketed. The bedplate is heavy and constructed for direct connection to generators or for belted work.

The engine develops 300 i. h. p., with 160 pounds initial pressure, cut off to one-half stroke, and will develop 500 i. h. p. under the same conditions with 26 inches vacuum. It requires not more than 14 pounds of dry steam per i. h. p. under the above named conditions, nor more than 15½ pounds when working under loads varying from 200 to 450 h. p. under the same conditions. The variation in speed does not exceed 1½ per cent. between friction and rated loads, as above, working either condensing or non-condensing. In case one-half of the load is suddenly thrown off or on, the momentary variation of speed does not exceed 2½ per cent., condensing or non-condensing.

As may be judged from the description and illustrations, the engine has been carefully and intelligently designed, and marks a distinct advance in engineering construction, while in power or central station practice, which the Field Engineering Company has already ameliorated in many directions, its use will produce corresponding results.

## A Universal Pull Lamp Socket.

We illustrate a convenient lamp socket manufactured by the Universal Pull Socket and Switch Company, 27 Beaver street, New York, whose good qualities will be appreciated not only by the user but by the supply dealer, who, instead of laying in a stock of complete sockets for each lamp base, will be able to fit a single type to any base in an inexpensive manner.



UNIVERSAL PULL SOCKET.

To turn off a lamp it will be seen that it is only necessary to pull the cord or chain, of which the pendent ball at its lower end may be a luminous one, thus facilitating turning on the light in a dark room. The pull always returns to its original position when released.

The socket is adapted for use with the Edison, Thomson-Houston and Westinghouse lamp bases, and makes and breaks the circuit by merely pulling the cord or chain, whether the lamp be arranged to project upward, downward or laterally, as shown in the cut. For the Thomson-Houston base no adjustment is required; all that is necessary to screw the central split screw of the socket into the screw hole in the front of the Thomson-Houston lamp. For the Edison base the screw neck illustrated must be inserted into the socket to do this. The two opposite screws in the bottom of the top cavity of the socket are slightly loosened, and then the screw neck is inserted in such a manner that the heads of the screws can pass through the diametrically opposite notches in its bottom flange; the neck is then given a quarter turn so as to cause the two hook prongs to pass under the heads of the screws, which, when set up light, secure the neck in position, and an Edison base lamp may then be screwed into the socket as usual. For the Westinghouse base the spring neck is inserted, as shown in the cut, and fastened in the same manner as the screw-neck for the Edison base. The lamp is then inserted and is held by the several prongs of the split spring neck, the pin on the foot of the Westinghouse base passing into the split hollow screw in the "Universal Socket," thus making the proper connection.

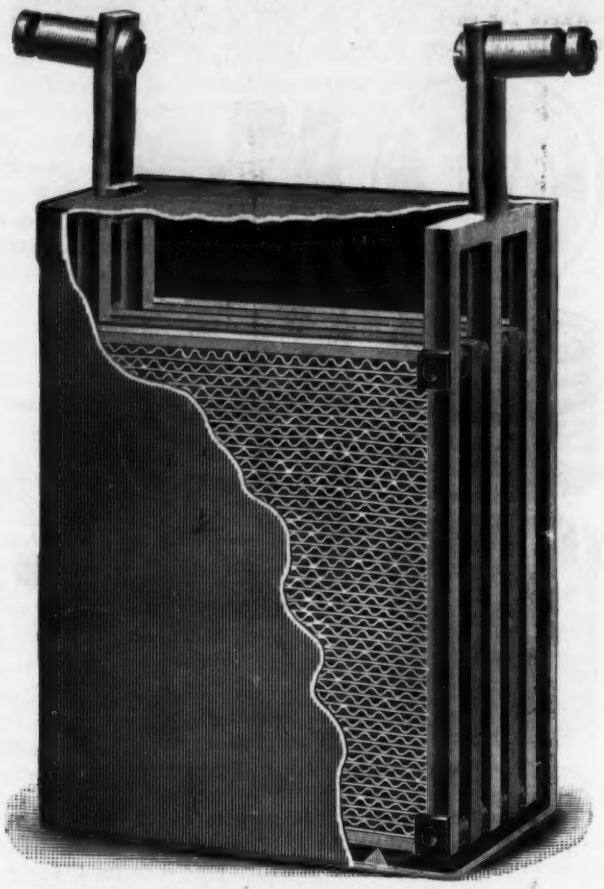
## A New Insulator.

We illustrate a new insulator recently placed on the market by McLeod, Ward & Co., 91 Liberty street, New York, which is not only strong and easily put up, but also neat and mechanical in appearance. The insulator consists of three parts, as shown, two of porcelain and one of iron. A wood or machine screw is cast in the iron part which is threaded at its upper portion; the triangular grooved piece of porcelain is inserted in the groove in the iron, the wire placed in position and the porcelain cap then screwed on, holding the wire firmly in position. There is a slight curve to the upper piece of porcelain so that when the lower piece is screwed up the wire is clamped firmly, and thereby bent slightly, so that it cannot be pulled in either direction. The insulators can be put up very readily without the use of a screwdriver or other tool, and are made in three sizes, to take wire from No. 18 to No. 12 B. & S. gauge; from No. 12 to No. 00 B. & S. gauge, and from No. 0 to No. 0 B. & S. gauge. A special size is also made for two wires in which the iron groove is much deeper, and a porcelain separating piece grooved in each end keeps the two wires two and one-half inches apart.

## The Franklin Accumulator.

The Franklin accumulator, shown in the accompanying illustration, is manufactured by the Franklin Electric Company, 136 Liberty street, New York City. It is the invention of F. K. Irving, and is of the lead-lead, Plante type. It has a working E. M. F. of about 2 volts. The plate consists of a marginal frame 6 by 7 inches and ⅜ inch thick,

filled with alternated straight and corrugated strips of lead. These strips are securely fastened into the frame by a specially prepared solder that is not affected by electrolytic action. The expansion due to the formation of peroxide is absorbed by the fluted strips; the corrugations become deeper, folding up on themselves,



THE FRANKLIN SECONDARY CELL.

and locking the peroxide into place so firmly, it is claimed, that it cannot be dislodged by the highest rates of charge and discharge. The frame, being of a harder metal than the interior lead filling, serves to stiffen the plates; it is but slightly affected by the process of forming. No pastes or applied oxides are used, the active material being formed entirely of and on the plate itself.

The construction of the plate exposes a very large surface to the action of the solution and current, and permits of high rates of discharge without a drop in potential. In the nine plates of the 150 ampere-hour cell there are 32 square feet of surface, and in the five plates of the 100 ampere-hour cell there are 18 square feet. When assembled in a pile, each plate is separated from its neighbor by three hard rubber sticks, ¼ inch square, placed equally distant from each other on the surface of the plate and so stiffening it that it cannot buckle. The outside separators cover the joints of the lead strips and frame.

The pile is held together by rubber bolts, which pass through the corners of the frames and through holes in the ends of the outside separators. The plates are securely connected by a lead bar having a terminal capable of carrying a current of twice the capacity of the cell. The internal resistance of the Franklin accumulator is about .0001 of an ohm.

The company cannot state from practical experience the length of life of these accumulators, but it is fair to suppose it is a durable cell, as the first ones made, about a year ago, have been in daily use, and show little or no signs of deterioration. Franklin accumulators having a capacity of 1,000 ampere-hours have been manufactured, and are now employed in lighting plants. Two sizes are carried in stock: Type "B" in rubber jar 4⅝ by 7⅞ by 10 inches, weighing complete 23¾ pounds, and having a capacity of 100 ampere-hours; type "C," 150 ampere-hours, weighing complete 42¾ pounds, the rubber jar measuring 7⅞ by 7⅞ by 10 inches.

### The Slater-Brown Automatic Engine.

The gridiron slide valve is in many respects an ideal form of engine valve, being compact and admitting of a large port opening with little motion, and this is one of the features of the engine we illustrate below, manufactured by the Slater Engine Company, Warren, Mass. Another good feature is separating the exhaust and admission valves, thereby reducing the condensation that results when the admission steam passes over parts cooled by the exhaust steam.

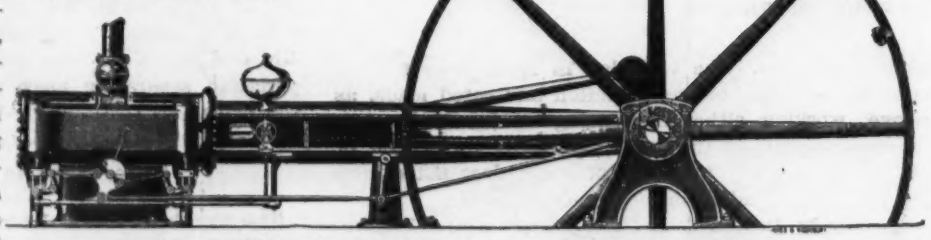


FIG. 1.—THE SLATER-BROWN AUTOMATIC ENGINE.

The construction of the engine and especially the arrangement of the valve gear will be comprehended by an inspection of the accompanying engravings, Fig. 1 showing the steam side of the cylinder with the wrist plates, steam valve operating mechanism, steam chests, etc. Fig. 2 is a section through the cylinder showing the steam valve *A* and ports *B*, valve connection, interior of steam chest, etc., as well as the exhaust valve *C* and ports *D*.

It will be seen that the wrist plate (Fig. 1), from which motion is transmitted to the steam valve, is on one side of the engine, while the exhaust is on the other. The motion is transmitted directly to the steam and exhaust valves through connecting rods, and bell cranks, *E* and *F*. The bell crank, *E* lifts a block *G*, engaging with the plate on the latch *I* which, on being raised, opens the valves. The latch *I* which holds the plate *H* has an inclined tail piece, as shown in Fig. 2. This extends below the upper end of the crank *J* on the governor shaft and when it is raised sufficiently to touch the crank head *J* the plate *H* will be disengaged from the block *G* and the valve by means of gravity, and the steam pressure, due to the area of the valve stem, will close quickly, making the cut-off nearly instantaneous. The

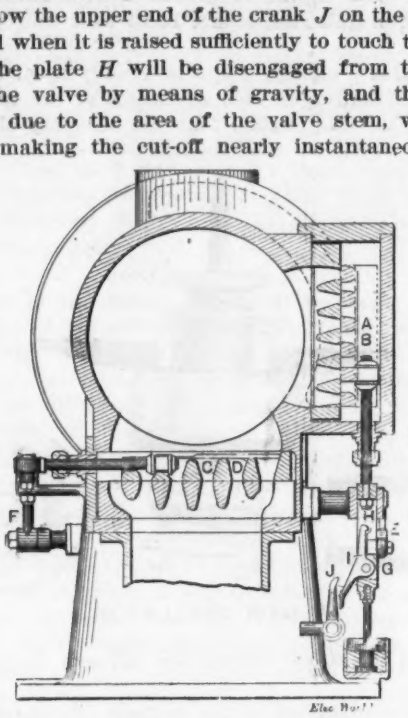
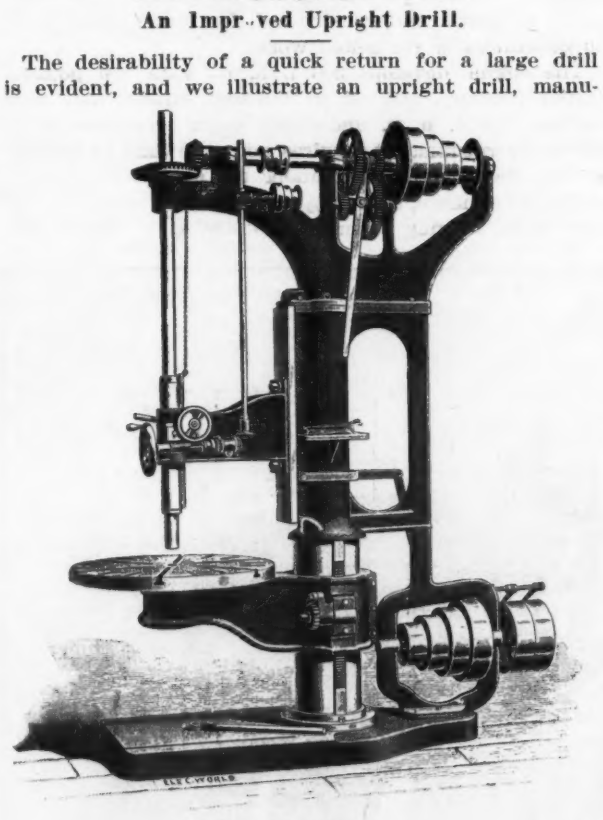



FIG. 2.—VALVES OF THE SLATER-BROWN ENGINE.

position of the crank is varied by the governor, according to the load and the boiler pressure.

### An Impr..ved Upright Drill.

The desirability of a quick return for a large drill is evident, and we illustrate an upright drill, manu-



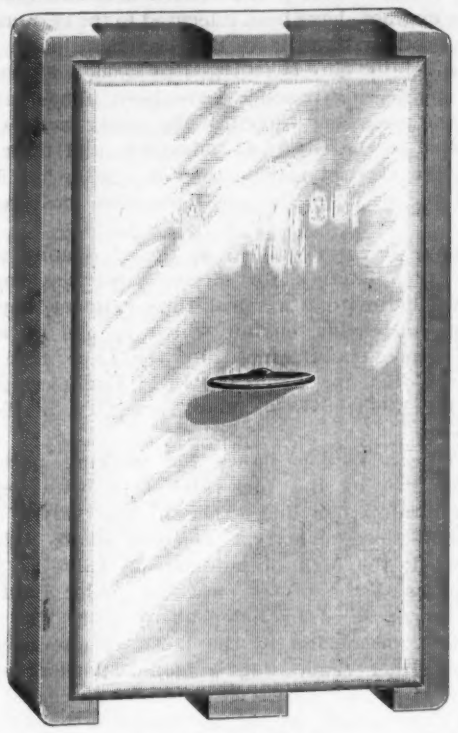
Upright Drill.

factured by P. Blaisdell & Co., 62 Jackson street, Worcester, Mass., in which this is one of the main features. The type illustrated has a swing of 50 inches and weighs 4,500 pounds. The frame is built stiff and heavy and the spindles are of steel. As will be seen, the drilling head is adjustable and the revolving arm and table are raised and lowered by a rack and pinion. It is fitted with self-feed and back gears, and has a check nut to prevent back-lash or drop in the spindle. The quick return motion is simple and reliable, and allows the drill to be returned rapidly, thus saving a great amount of time.

### A New Cut-Out.

Notwithstanding the great variety of automatic cut-outs for incandescent lighting, which have reached a considerable degree of perfection at the present time as compared with the wooden "tinder boxes" used in the early days of electric lighting, improvements, of a minor nature, yet of considerable importance in practice, are still being made.

In this line, the new style of main and branch cut-outs, which are being put on the market by the Iona Manufacturing Company, of Boston, posseses some



THE IONA CUT-OUT.

points of merit. The general appearance of the main cut-out is shown by the accompanying cut. The wire contacts are of the well known Sawyer-Man style, making a solid connection with wires of various sizes. Fuses are protected by porcelain covers or mica if desired, which can be easily removed by unscrewing the thumb nut in the centre, when replacing burned out fuses.

### NEW BOOKS.

Praktische Dynamokonstruktion. By Ernest Schulz. 60 pp.; one plan and 42 cuts. Berlin: Julius Springer. 1893. Price, 3 marks.

The intention of this book is to describe in a plain and simple manner how to calculate the proportions of a dynamo electric machine. It consists of two portions, the first of which deals with the magnetic features, and the second with the electric features. The formulae throughout appeared to be of the very simplest kind, none of them being too complicated to be used by the practical engineer. Throughout, the subject appears to be treated in an eminently practical manner, involving none but the simplest kind of mathematics; his treatment of the subject is made all the more acceptable to engineers by the fact that he has worked out practical examples in each case, showing the application of the formulae. Unlike in so many other German books, the author shows his good judgment by not beginning with a history of the science of electricity from its commencement, but, on the contrary, he assumes a knowledge of the fundamental principles, as also a knowledge of dynamos. The book is intended more for students, but it would seem to us to be of great value also to the constructor. The readers of the Digest will have already become familiar with the practical way in which Mr. Schulz treats subjects in his papers, a number of which have been abstracted in that department. The book can be recommended to students and to designers of dynamos who are able to read the German language.

Objects of Interest to Engineers and Others In and About the City of Philadelphia. Published by the Engineers' Club of Philadelphia, 1893. 10 pp., 4 maps.

This little work, a copy of which has just been sent us, contains, doubtless, the best summary of the objects of interest in that great manufacturing city; it was compiled under the direction of the local engineers' club (chiefly by a member whose name does not appear as the principal compiler), for the benefit of engineers visiting that city and who desire to have a list of the points of interest in and about that city. It is doubtless the most complete, if not the only, book of the kind published, and can be highly recommended to engineers who desire to see the many points of interest, while it is at the same time an interesting list of the engineering features of Philadelphia. While the arrangement of the subjects is perhaps not the most convenient for an engineer desiring a list of the objects in his particular branch, it is doubtless the best arrangement, considering the wide range of subjects covered by the various engineering branches. Descriptions of some of the most interesting features are given, besides which frequent references are made

to books, reports of officials, etc., from which further information can be obtained. Asterisks are used to call attention to the relative importance of the most interesting features. The maps include a complete map of the city, another of the central portion, and two maps, one of the Pennsylvania and another of the Philadelphia & Reading railroad systems. We recommend visiting engineers to obtain a copy of this book, which they can do by applying to the headquarters of the engineer's club of that city.

ARITHMETIC OF MAGNETISM AND ELECTRICITY. By John T. Morrow, M. E., and Thorburn Reid, M. E. Lynn, Mass.: Bubier Publishing Company, 1893. 145 pages. Price, $1.

The object of this arithmetic is stated to be "to enumerate all those rules of electricity and magnetism which are directly connected with their commercial applications and to give numerical examples of each. There has been no attempt at explanation of the phenomena involved, although in some cases some of the more obvious deductions from the rules have been indicated."

To those who are willing to trust blindly to set rules and who do not care for the principles upon which they are based, this little work may be of some assistance in working out minor problems. Some rules and examples are given relating to dynamo design and higher problems, but it would be dangerous, in the absence of knowledge of the underlying principles, to depend upon these alone in any case.

Some of the rules are not at all clear, of which the following is an example:

"The current of a battery whose cells are arranged in multiple series is equal to the electromotive force of the cell, multiplied by the number of cells in each series divided by (the internal resistance of a cell multiplied by the number of cells in series divided by the number of series plus the external resistance of the circuit)."

Had the book dispensed with rules entirely and followed logical statements of principles by numerical examples, its value would be much greater.

POPULAR ELECTRIC LIGHTING Being Practical Hints to Present and Intending Users of Electric Energy for Illuminating Purposes, with a Chapter on Electric Motors and on Heating and Cooking by Electricity. By Captain E. Ironside Box, General Manager of the Westminster Electric Supply Corporation, Limited. Second Edition. London: Biggs & Co., 1892. 159 pages; 45 illustrations. Price, 75 cents.

This book, we are informed, was gotten up to supply to those who contemplate substituting electricity for existing illuminants, as well as to those who have already made the change, such information as is not readily obtainable without reference to many sources. The points touched upon are such as the author knows from numerous inquiries addressed to him to be those upon which information is most required by the class referred to. For this definite purpose the book will be useful.

LITERARY NOTES.

The National Electric Light Association has published in pamphlet form the lecture on "Light and Other High Frequency Phenomena" delivered before that Association at St. Louis during its spring meeting by Nikola Tesla, and which was published in The Electrical World in full in its issue of June 3, 1893.

The pamphlet is a handsome one, the typographical execution being exceptionally fine. The Association is to be congratulated upon its enterprise in arranging for this notable contribution to science, and its efficient secretary, Mr. Porter, for the creditable style in which it is published.

# Financial Intelligence.

## THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 21, 1893.

THE ELECTRIC STOCK MARKET continues to be featureless. Quotations vary but slightly and transactions are limited. Though the market was stronger at the close of the week than on the opening day, there has not been a good, substantial rise in quotations. Electric securities have not shown any further tendency to resume their position of a few months ago as the leaders in the speculative industrial stocks. The interest in them seems to be lagging. Meanwhile, during this stagnation in the stock market, idle money is pouring into New York. To-day's bank statement shows that $11,052,400 in legal tenders has been added to the surplus and that deposits have increased $9,230,700. This addition in funds will force down time-money rates and may ultimately produce more activity in electrical stocks, but it is not probable that the market will have any material benefit from it until Congressional action is taken on the silver question. Investors and operators are loath to purchase securities until they know what place silver is to occupy in the national currency. When Congress arrives at some decision in the matter, the lethargy in which electric stocks have fallen in common with other industrials may be broken.

GENERAL ELECTRIC stock has made a gain of two points during the week, and it has been as strong as any of the industrials. It is reported that there will soon be a resumption of work at the Lynn factory upon a scale of a few months ago. The weekly payroll at the Thomson-Houston works is now said to amount to $25,000. The reduction of 10 per cent. in wages to returning employees continues. These are encouraging business facts, but the stock now quoted at 45 is at a remarkably low figure for a good dividend security. The quotation ably illustrates the depressed condition of the market.

EDISON ELECTRIC ILLUMINATING has not been very active, but its quotations are gaining ground. The closing bid today was 96¼, which is an advance of six points during the week. The stock is offered at 100; this, being 3¾ points above the bidding price, shows that it is considered a valuable security. The progress the Edison illuminating companies are making in the United States is shown by the statement published, saying that the St. Louis electric lighting companies, both incandescent and arc, have been absorbed by the local Edison company. This combination brings all the electric companies of St. Louis under the management of the Edison company.

FORT WAYNE ELECTRIC STOCK has dropped a few more points from its exceedingly low quotation. Confidence seems to be shaky in the status of the company. The recent development of the connections of one of the company's officials with a New York bank will not add to a restoration of faith in the corporation. The stock is now offered at 4, while the bid is but 2½.

WESTERN UNION has made a net gain of three points during the week, and closed at 83⅝. This quotation is but 12 points below the stock's normal standing. The company's annual report has had an appreciating effect upon the stock.

THE TRUSTEES OF THE THOMSON-HOUSTON SECURITIES, Series D, have declared a semi-annual dividend of 25 cents per share, payable Nov. 1. Transfer books closed Oct. 4.

ELECTRICAL STOCKS.

| | Par. | Bid. | Asked. |
|---|---|---|---|
| Brush Ill., New York | 50 | 20 | 35 |
| Detroit Electrical Works | 10 | 2 | 3 |
| East River Electric Light | 100 | .. | 65 |
| Electric Con. & Supply Co. pref. | 15 | 15 | 16 |
| " " " " " com | 15 | 15 | 17½ |
| Edison Electric Ill., New York | 100 | 96½ | 100 |
| " " " 1sts | ... | 104 | 105 |
| Edison Electric Ill., Brooklyn | 100 | 93 | 97 |
| " " " Boston | 100 | 115 | 130 |
| " " " Chicago | 100 | 220 | 230 |
| " " " Philadelphia | 100 | 120 | 125 |
| Edison Electric Light of Europe | .. | 2½ | 5 |
| " Bonds | .. | 80 | 85 |
| " Ore Milling | .. | 5 | 12 |
| Fort Wayne Electric | .. | 2¼ | 4 |
| General Electric Company | 100 | 45 | 45¼ |
| " " deb. 5's | ... | 75 | 76 |
| Interior Conduit and Ins. Co | 100 | 25 | 35 |
| Mount Morris Electric | .. | .. | 65 |
| Westinghouse Consolidated | 50 | 21 | 22 |
| " " pfd | 50 | 41 | 43 |

## NEW INCORPORATIONS.

THE FOREST CITY ELECTRIC RAILWAY COMPANY, Scranton, Pa., capital stock $30,000, has been formed to construct and operate an electric railway. M. Moran, Carbondale, J. O'Brien and J. P. Kelly, Scranton, Pa., are interested.

THE GREEN ELECTRIC SIGNAL COMPANY, Kittanning, Pa., capital stock $50,000, has been formed to manufacture articles made of wood, steel, iron or other metals. M. D. Wayman, Ford City, Pa., I. L. Green and G. M. Fox are the promoters.

THE CARBONDALE & DUNDAFF STREET RAILWAY COMPANY, Scranton, Pa., capital stock $30,000, has been formed to construct and operate an electric railway. M. Moran, Carbondale, J. O'Brien and J. P. Kelly, Scranton, Pa., are the parties interested.

THE ONGLEY COMPANY, Hoboken, N. J., capital stock $25,000, has been formed to make and sell electrical and other devices and appliances. The promoters are G. M. Keasby, Newark, N. J.; C. E. Ongley, G. B. Hopkins, W. P. Dixon, Jr., W. Miller, and G. J. Schoeffel, New York City.

THE TAYLOR SWITCH AND SIGNAL COMPANY, Chillicothe, O., capital stock $24,000, has been formed to manufacture and sell railroad switches and signals, and electrical and other machinery for various purposes. The organizers are J. D. Taylor, R. Enderlin, C. A. Smith, J. M. Vanneter and W. L. Tulleys.

THE CHARLES S. SOLOMON COMPANY, Camden, N. J., capital stock $30,000, has been formed to manufacture, construct and repair machinery and apparatus for electrical and mechanical purposes, etc. The incorporators are C. S. Solomon, W. S. Griffiths, J. S. Mount, Philadelphia, Pa., and A. H. Gangewer, Burlington, N. J.

THE PACIFIC COAST PRINTING TELEGRAPH COMPANY, Los Angeles, Cal, capital stock $1,000,000, has been formed to manufacture and deal in printing telegraph machines and electrical appliances, and to operate lines and exchanges. Forbes Parker, D. Potter, D. Stone, San Diego, and M. T. Allen, Los Angeles, Cal., and C. F. Dunderdale, Chicago, Ill., are interested.

# Special Correspondence.

## NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Oct. 21, 1893.

MR. WM. J. HAMMER has returned from a two weeks visit to the World's Fair.

MR. J. E. HAM, general sales agent for Kerite wires and cables, 203 Broadway, New York, has returned from a successful southern trip.

MR. H. L. PARKER, president and manager of the Emerson Electrical Manufacturing Company, St. Louis, Mo., was in the city, Wednesday, Oct. 18.

MR. R. B. COREY, of the Electric Construction and Supply Company, 18 Cortlandt street, New York, has returned from a week's visit to the World's Fair.

MR. FRANKLIN BROOKS, of the firm of Eugene Munsell & Co., 218 Water street, New York, who has been confined to his home, Elizabeth, N. J., during the past week, with a severe cold, has fully recovered.

THE NEW YORK HERALD arraigns the Brooklyn City ring for throttling all electric arc light competition in favor of two companies said to be controlled by McLaughlin, Shevlin and other members of the ring.

MR. W. T. M. MOTTRAM, formerly representing the General Electric Company in the Southwest, is now negotiating for a business position in the Eastern States. He is now located in the Havemeyer Building, Room 1302.

THE BROOKLYN ELECTRIC MANUFACTURING COMPANY is now making the largest switchboard it ever produced. It has 55 switches, ranging from 25 to 2,000 amperes, and is for the new Vanderbilt residence in Fifth avenue, New York.

THE H. & H. ELECTRIC MANUFACTURING COMPANY, 136 Liberty street, New York, has opened a commodious shop at 22 and 24 Morris street, Jersey City, where it has a force of skilled men engaged in repairing electrical apparatus.

MR. F. R. CHINNOCK, 18 Cortlandt street, New York, general Eastern sales agent for the Ball Engine Company, Erie, Pa., reports having closed during the past week a number of large orders for engines manufactured by his company.

THE LEMAIRE DECORATIVE AND ELECTRICAL MANUFACTURING COMPANY is making preparations to remove from 258-260 Eleventh avenue. It expects to be located either in Greenwich street, near Desbrosses, or in Sixty-sixth street, near Ninth avenue.

MR. LOUIS STEINBERGER, president, and Mr. I. W. Rubel, secretary and treasurer of the Electros Manufacturing Company, made a joint trip to Chicago, and there separated, Mr. Steinberger going to the Northwest and Mr. Rubel traveling South. Both are expected home before the first of November.

## NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 21, 1893.

THE MATHER ELECTRIC COMPANY has filed with the State Secretary a certificate of reduction of capital stock from $200,000 to $120,000; also a certificate showing that the stock of the company was increased by the issue of preferred stock to the amount of $81,000, entitled to a non-cumulative dividend of six per cent.

THE RAILROAD COMMISSIONERS this morning inspected the location for electric cars on Brattle street, Old Cambridge. Those who drove over the location were Chairman Sanford and Commissioner Dale, inspecting officials; City Solicitor McIntire, City Messenger Francis L. Pratt, representing the city, and Mr. J. B. Warner and J. G. Thorp, representing the people of Brattle street.

AT THE ANNUAL MEETING of the stockholders of the Edison Electric Illuminating Company, of Fall River, Mass., the treasurer's report showed that the company had enjoyed a prosperous year, and had added largely to the plant. A quarterly dividend of two per cent. was declared. The following officers were elected: Clerk and Treasurer, A. F. Dow; directors, J. C. Bordo, F. S. Stevens, J. B. Harley, A. F. Dow, J. Crossley, W. R. Woodman and W. S. Whitney.

THE FIRST of the big engines in the big power house of the Union Railway Company, of Providence, which is a portion of the big railway syndicate property, was formally turned this morning. Director Chas. W. Perkins, who has had practically the entire charge of erecting the plant, turned the steam on. There are three Greene compound engines of 750 h. p. run by three batteries of six Babcock & Wilcox boilers of 1,500 h. p. of steam in the aggregate. These engines are belted directly to the generators of 500 kw. each, built by the General Electric Company. There are two more engines contracted for of 1,100 h. p. each, which will be coupled directly to generators. The interior of the engine room is 170 by 72 feet, and the boiler room 104 by 72. The company will use its own electric current on the street cars on Nov. 1. At present the power is furnished by the Narragansett Electric Lighting Company.

## WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
36 MONADNOCK BUILDING, CHICAGO, Oct. 20, 1893.

THE METROPOLITAN ELECTRIC COMPANY, offices 319-320 Manhattan Building, and salesroom 307 Dearborn street, recently organized, will make an announcement shortly as to the scope and general plan of the company. In the meantime they are receiving orders for general supplies and N. I. R. wire. Mr. Wm. H. McKinlock, of the company, feels that the outlook for business is encouraging and sees the promise of liberal support for a good, strong company conservatively managed.

OREGON CITY, Ore., Oct. 15, 1893.

THE HILLSBORO ELECTRIC LIGHT AND WATER COMPANY, of Hillsboro, Ore., has been incorporated, with a capital stock of $40,000.

THE OREGON TELEPHONE AND TELEGRAPH COMPANY, of Portland, recently opened its through service to Spokane, Wash., connecting with the Inland Telephone Company's line, which has been extended to meet the Oregon line, the distance via the combined lines being 450 miles. This line, a metallic circuit of copper, works perfectly and is well patronized, the tariff being $3 for a three-minute conversation. By connecting with the lines of the Sunset Telegraph and Telephone Company in the State of Washington, communication can be carried on between Everett, Wash., and Wardner, Idaho, the distance being 800 miles via Tacoma, Portland and Spokane, making the second longest telephone line in the United States. Manager J. H. Thatcher, of Portland, is confident that the Pacific Northwest system will be a great success, notwithstanding the difficulty of keeping the lines up through a wooded and mountainous region in winter. The Oregon telephone system extends as far as Eugene, 120 miles south of Portland, while the Sunset Telephone and Telegraph Company's southern lines extend as far north as Redding, Cal., leaving a gap of little more than 300 miles to be covered to make a complete telephone circuit of the Pacific Coast.

## CANADIAN NOTES.

OTTAWA, Oct. 19.

LIVERPOOL, N. S.—F. Hutchinson has secured the contract for the electric lighting plants for the pulp mills at Milton and at New Germany.

TRURO, N. S.—This town has decided to have an electric street railway, and the road is to be completed and equipped in 18 months. The company is composed of Martin Dickey, J. A. Leaman, F. A. Lawrence, S. G. Chambers, William Craig and P. Archibald.

FREDERICTON, N. B.—The City Council has decided to accept the offer of the Fredericton Gas and Electric Light Company to light the streets of the city by electricity for 10 years at the rate of $55 per light per year, and the city clerk is instructed to prepare a contract for the same.

HALIFAX, N. S.—The tenders of the Illuminating and Motor Company for street lighting have been accepted for a term of three years as follows: 150 2,000-c. p. arc lights at $78.75; 50 1,200-c. p. arc lights at $72.75; 50 50-c. p. incandescent at $23.87; 50 32-c. p. incandescent at $17.52, the city reserving the right to increase the number of arc or incandescent lights as they may desire at the contract price per light.

MONTREAL.—An arrangement has been entered into by the customs authorities with the Auer Incandescent Light Company, which is at present under seizure by the Customs Department for undervaluations. The customs first desired the company to give an accepted check for $10,000, pending the settlement of the matter. This the company did not desire to do, and negotiations were entered into between Mr. Bell, the general superintendent of the company, and the department at Ottawa. The result was that Mr. O'Hara, the acting collector, received instructions to permit the company to continue its business as usual, upon the deposit to the customs of $1 for every light that it sent out and 20 cents for every mantle. This will enable the Auer company to attend to any new business that may come in.

OTTAWA, ONT.—W. Y. Soper, of Ahearn & Soper, who constructed and own the greater part of the electric street railway system in this city, has just returned from the Continent, where he has been inspecting the various street railway systems in operation in that quarter of the globe. In speaking of the electric roads seen by him on the Continent, Mr. Soper says that there is a nicely equipped electric railway system in Dresden, while in Paris he saw a storage battery road. At Liverpool he inspected the elevated electric system, covering a distance of seven miles, which was generally considered as the best constructed railway in the world. Being elevated, the trolley wire was dispensed with, and instead the electric circuit was formed by means of a third rail laid between the two track rails. Outside of Germany, he thinks America far and away ahead of Europe in electrical matters.

CANADIAN ELECTRIC ROADS.—The receipts of the Montreal street railway for the year ending Sept. 30 were $750,754, being $186,357 in excess of the previous year. This is the first year of the present company's management and the first year of an electric service on the road. Only a part of the system has been operated by electricity. The receipts of the Toronto street railway for the year 1892 were $815,212, slightly higher than Montreal's receipts, although, like Montreal, Toronto was converting her system to an electric one. The receipts of the Ottawa Electric street railway for the year ending July 1, 1893, were $130,000. These figures enable a comparison of the three cities as regards the patronage given to street cars per head of population. Taking the population as by last census, the comparison is: Toronto, 181,220 population; $815,212 street car receipts; $4.49 fares per head. Montreal, 216,650 population; $750,754 street car receipts; $3.47 fares per head. Ottawa, 44,154 population; $130,000 street car receipts; $2.94 fares per head. Ottawa, apparently, is therefore nothing like comparatively as good a street car town as either Toronto or Montreal. Although Montreal's rate of receipts is less than Toronto's, Montreal is a much smaller city as regards area, and therefore less expensive to a good street car service, which makes up somewhat for her lesser patronage of street cars per head of population. Ottawa, on the contrary, has not only the less patronage, but a comparatively big area.

## ENGLISH NOTES.

*(From Our Own Correspondent.)*

LONDON, Oct. 11, 1893.

THE EDISON-SWAN INCANDESCENCE LAMP PATENT.—The impending expiry of this patent in this country and the recent reduction of the price of lamps is causing considerable excitement in the electric light trade at the present time.

THE DERBY ELECTRIC POWER STATION.—On the 10th inst. the formal inauguration of the new electric power station at Derby took place by the mayor. The generating station is situated near the river, which supplies abundance of condensing water. The entire supply is by alternating currents on the transformer sub-station system, there being at present ten of these sub-stations at work. It is remarkable that the frequency adopted for the current is as low as 40 alternations per second; the primary mains are at 2,000 volts and the low pressure network is maintained at the feeding points at 105 volts. The station and system of mains have been carried out from the designs and under the supervision of Messrs. Bramwell and Harris.

# News of the Week.

## ELECTRIC LIGHT AND POWER.

VERNON, MICH., is to have electric lights.

GALLATIN, MO., is talking about having electric lights.

BROWNSTOWN, IND., is discussing the electric light question.

JAMESTOWN, N. Y., wants an improved electric lighting plant.

TREMONT, ILL.—The electric lighting question is being discussed.

UNADILLA, N. Y., has adopted the incandescent electric light system.

CHAMPAIGN, ILL.—A new electric light company is to begin business.

MONETT, MO.—The Village Council is considering the erection of an electric light plant.

ONTARIO, CAL.—The business men are agitating the question of lighting the city with electricity.

SPRINGFIELD, MO., is discussing the question of bonding the city for $50,000 for a municipal plant.

BOWIE, TEX.—The city has issued $9,000 in bonds for waterworks and electric lights. G. N. Freeman can give information.

PALMYRA, N. Y.—Prominent residents are talking about getting up an electric light company. Nothing definite has yet been done.

GRAHAM, VA.—An electric light and power plant will be erected by the Graham & Bluefield Electric Light and Railway Company.

EAST DUBUQUE, ILL.—The East Dubuque Council has closed a contract with the Star Electric Light Company, of Dubuque, to furnish lights.

WATERFORD, N. Y.—A special meeting of Village Trustees will soon be called to take action in the matter of the increase in the street arc lights.

CLEAR LAKE, IA.—The city voted to build an electric lighting plant. The work is not likely to be done until next year. J. H. Woodstock is interested.

CHEBOYGAN, MICH.—Messrs. Moloney & Fisher have made application for a franchise to establish an electric light plant and to do private and public lighting.

LITITZ, PA.—Director Bucher, of the electric light company, states that the proposed electric light plant will cost $20,000 and that work will ere long be begun.

WORCESTER, MASS.—The Committee on Sewers has voted to put in an electric lighting plant at the Quinsigamond Purification Works, and to enlarge the laboratory.

LINCOLN, NEB.—The city will vote at the November election on issuing bonds for $1,500,000 for constructing the Platte River Canal, and electric light and water-works plant.

BATH, PA.—Town Council of Bath has decided to procure the best light possible, and they will purchase an electric equipment as soon as a site for the station can be located.

HARRISONVILLE, MO.—The $12,000 electric light bonds have been registered, and as soon as they are sold work will be commenced on the construction of the electric lighting plant.

CHESTER, PA.—The new electric light and power company, in which C. M. Ryder is interested, will award contracts as soon as Borough Council takes favorable action on their petition.

YARMOUTH, ME.—At a meeting of stockholders of the Yarmouth Manufacturing Company it was decided to purchase a 50-h. p. engine for auxiliary power, with boiler, for the electric light works.

STERLING, KAN.—The Sterling electric light plant was destroyed by fire. The plant was the property of J. H. Ricksecker, of Kansas City. The loss is about $6,000, with little insurance.

NEWARK, N. J.—Freeholder Cahill, of the Public Building Committee, has recommended that a new heating plant and an electric lighting plant be put in the asylum, and that a fire brigade be organized and equipped.

MADISONVILLE, O., has issued bonds to the amount of $15,000 for the purpose of erecting an electric light plant for street and commercial lighting. Plans and specifications will be ready within the next 10 days.

NUTLEY, N. J.—Dr. Thomas E. Satterthwaite is contemplating extensive improvements to his Nutley Heights property this fall. Among other improvements will be electric lights and water mains from the Nutley Water Company works.

BALTIMORE, MD.—Secretary Henry C. Tudor, of the Brush Electric Company, whose plant was recently burned, states that the company will rebuild just as soon as site can be selected, as they have not yet decided to rebuild on the old site.

NORTHAMPTON, MASS.—The Northampton Electric Light Company has had plans and specifications prepared for the erection of a plant. Bids will be called for and the work will be completed for occupancy early in the spring. Estimated cost $30,000.

ALTOONA, PA.—Common Councilmen Hawk, Shellenberger and Ward have been appointed a committee to inquire into the feasibility and cost of an electric lighting plant for Altoona and to report same to joint meeting of Councils at their earliest convenience.

PITTSBURGH, PA.—A company headed by J. Umbstetter and James Oliver has been formed in Pittsburgh to operate phosphate beds at Bartow, Fla. The capital stock of the company is $150,000, and they propose to introduce electricity for power on their dredge boats.

ALAMEDA, CAL.—The Board of Trade is circulating a petition asking the City Trustees to grant a franchise to some responsible person or corporation for maintaining an electric light plant in Alameda. The merchants want to light their stores by electricity instead of by gas.

PALMYRA, N. Y.—Carlton C. H. Hunt and B. H. Davis were granted a franchise over a year ago to put up an electric light plant for street and general lighting purposes, and they filed a bond for $2,000, but it is evident that they do not intend to fulfil their contract, and residents have given up hope.

HILLSDALE, MICH.—The Jonesville Electric Light and Power Company, of Jonesville, has made a proposition to light the city. Their proposition is for 45 or more arc lights to burn for half an hour after sunset until 1 a. m. every night in the year, for $60 for each light, or they will run all night for $70 for each light.

BUFFALO, N. Y.—The Buffalo & Niagara Falls Electric Light and Power Company has taken possession of the plant of the Brush Electric Company. Some time ago they were awarded the contract for electric street lighting and they propose to improve the plant. J. P. Chapin, of Buffalo, is superintendent.

ESTHERVILLE, IA.—The Burlington, Cedar Rapids & Northern Railway has just completed an independent electric plant to light shops, depot and general offices at this place. The question of putting in a plant to light the town is being discussed by the City Council, and steps will be taken to secure lights for the city.

ATLANTA, GA.—The Committee on Street Lighting meets on the afternoon of the 21st inst. to take action in the matter of the proposed electric light plant, as advocated by Mr. Dimmock and Mr. Stephens. President Atkinson, of the Georgia Electric Light Company, claims that the city cannot light the streets cheaper with a municipal plant than his company.

COAL CITY, ILL.—Proposals will be received and contract awarded to the lowest responsible bidder by the village of Coal City, Grundy County, Ill., in its Village Hall, for the erection and completion of an electric light plant, and the furnishing of all materials, machinery, poles and wire, and everything pertaining thereto, together with power house and boilers complete. All correspondence should be addressed to W. G. Suffern, Village Clerk.

ROCHESTER, N. Y.—Alderman Dewey and City Electrician Barnes have reported that the arc system in use now on Fifth avenue, New York, is the best, and the aldermen have adopted a resolution authorizing the electrical committee to negotiate with the gas and electric company for the erection of iron poles. The Rochester Street Railway Company will also be asked to remove all wooden poles on Main and State streets and substitute iron poles.

NEWTON, MASS.—The street lighting committee of the Newton City Council is preparing a report covering the advisability of purchasing an entire new plant, and also the cost of the present plant of the Newton & Watertown Gas Company, which now has the contract for supplying this city with gas and electric lights. It is believed that the city cannot legally be compelled to purchase the existing plant, as it lies outside the city limits and wholly in Watertown.

## THE ELECTRIC RAILWAY.

ERIE, PA.—Mayor Scott has signed the ordinance giving the Erie & Edinboro Railroad right of way.

HURON, O.—An effort is being made to raise capital for an electric line six miles long to Hull's Corners.

THE CHICAGO, ILL., CITY RAILWAY COMPANY has projected an extensive electric railway system for the south side.

MINNEAPOLIS ELECTRIC RAILWAY officials are thinking of putting a funeral train to run to the twin city cemeteries.

BUFFALO, N. Y.—W. B. Cutter, of Buffalo, is interested in the electric road to be built to Depew during the coming summer.

PORT JERVIS, N. Y.—There is talk about an electric road and there is a probability that such a road will be built next spring.

TUCKERTON, N. J.—The Philadelphia "North American" is authority for the statement that a bicycle railway is to be built to Edge Cove.

ELIZABETH, N. J.—A trolley franchise for Elizabeth has been granted by the Union County Freeholders to the Consolidated Traction Company.

THE PENNSYLVANIA RAILROAD COMPANY is contesting the right of the Lancaster & Philadelphia Electric Railway Company to run through rural districts.

WEST CHESTER, PA.—J. Clemson Sharpless, civil engineer, has completed the survey for the proposed electric line to Philadelphia, Pa., a distance of 28 miles.

WIND GAP, PA.—Messrs. Stroh and Wren, respectively president and secretary of the company which proposes to build an electric road to East Bangor, have bought land at Bangor for a power house.

SOUTH BETHLEHEM, PA.—The franchise for the Lehigh Valley Traction Company has been granted by the South Bethlehem Council on condition that residents are to be given first chance at the work.

CHESTER, PA.—Work on the proposed Chester & Wilmington electric road will be commenced in the spring, and an independent power plant will be built at Marcus Hook, Pa. Recorder Kerlin, of Chester, Pa., is interested.

PORT JERVIS, N. Y.—The Port Jervis correspondent of the Elmira "Telegram" is authority for the statement that capitalists from Scranton have been looking over the ground with a view to locating an electric street railway there.

WHITEFISH BAY, WIS.—Supervisor Isenring states that the village of Whitefish Bay will build an electric line to Milwaukee in the spring. A mass meeting was held, and two-thirds of the villagers voted in favor of bonding the village to build the line.

WATERBURY, CONN.—The contract for building the electric car road between Waterbury and Naugatuck has been awarded by the Waterbury Traction Company to H. S. Tuttle, of Boston, Mass. The road will likely not be finished before the spring.

MONTCLAIR, N. J.—The Montclair correspondent of the Newark "Sunday Call" is authority for the statement that a party of surveyors have been in town, and that they state that they are the forerunners of an electric road. Nothing definite can be stated.

BEL AIR, MD.—The Hughes & Rigby Company, of Baltimore, who have the contract to build electric light plants at Bel Air, and at Havre de Grace, are going over the proposed line between these two points looking to the feasibility of building an electric line.

LOS ANGELES, CAL.—The Board of Supervisors sold the franchise for an electric railway between Los Angeles and Pasadena to W. D. Larabee, representing the Consolidated Electric Railway Company. Work is to be commenced within 90 days and will be completed within 12 months.

SAN FRANCISCO, CAL.—A combination of street railways, which has been in progress some time, is at last completed, with a capital stock of a little more than $18,000,000. Of this the Southern Pacific controls 76 per cent. The combination includes 16 street car lines and controls nearly all routes of travel in the city.

WASHINGTON, D. C.—Residents of the Mount Pleasant district have appointed a committee to wait upon the commissioners in the matter of the applications for franchises for the Rock Creek Railway and the Washington Traction Company. Jas. W. Summerville, E. W. Woodruff and W. B. Matthews are the committee.

PHILADELPHIA, PA.—Director Boitler has given permission to the Moyamensing & Penrose Ferry Road Passenger Railway Company to build a trolley line to connect the extreme southwestern and southeastern parts of the city. Work will be begun about 1st of March next, and it will be in running order about five months from that time. A meeting was held at Willis Hotel, in Wilmington, Del., and James McComb, of Wilmington, was elected president. It was decided to call 10 per cent. of the stock, and Nov. 30 was set for the actual comcent. of the stock.

PITTSBURGH, PA.—The ordinance granting a franchise to the proposed Pittsburgh & Mansfield Railway came up at Council meeting, and after a lively session it was unanimously recommended. This is the company which proposes to expend $500,000 in bridging the Monongahela River and tunneling Mount Washington for an electric railway.

NORRISTOWN, PA.—A project is on foot to buy or lease the Stony Creek Railroad, running to Lansdale, a distance of a little over 10 miles, and abolish the use of steam cars and substitute electricity by the trolley system. David S. Heebner, postmaster of Lansdale and a director and stockholder in the Stony Creek road, is the projector of the new arrangement.

BATH, ME.—The syndicate which secured the original charter for a street railway in Brunswick and Topsham have sold the charter to the Bath Street Railway Company, composed of Galen C. Moses, F. H. Twitchell, and A. H. Shaw, of Bath, Me., and A. F. Gerald, of Fairfield, and they will build and operate the road in the early spring. There will be at least 15 miles of new road.

BOONSBORO, MD.—Officials of the proposed electric road between here and Keedysville state that the road will be in running order by Jan. 1 next. The company was incorporated under the name of the South Mountain Railway and Electric Light Company. Work will at once be commenced. Contracts for rails and ties have been awarded and the franchises have been perfected.

BUFFALO, N. Y.—A corporate charter has been granted by the State of New York to the Buffalo & Niagara Falls Electric Railway Company, with a capital of $1,000,000. The stock-

holders organized this week in New York by the election of the following officers: President, W. C. Ely, of Niagara Falls; vice-president and general manager, J. A. Powers, of Lansingburgh, N. Y.; treasurer, Frederick Swift, of New York. Next spring the company proposes to build and operate an electric trolley railway between Buffalo and Niagara Falls. The road will be about 20 miles in length, connecting with other roads with which traffic arrangements have been made. The syndicate was organized by Mr. Powers, who represents a pool which now controls four electric street railways.

## LEGAL NOTES.

THE RUSSELL ELECTRICAL MANUFACTURING COMPANY, of Providence, R. I., has commenced a lawsuit in the U. S. Court, Utica, against the Utica Electric Manufacturing and Supply Company, Utica, N. Y., for infringement of patents on the Russell mast-arm, claiming heavy damages.

THE AMERICAN BELL TELEPHONE COMPANY has begun suit in the United States Circuit Court against the Grand Rapids, Mich., Refrigerator Company to restrain them from the further use of patented electrical devices claimed to be owned by the Bell company, and to collect damages for the time the refrigerator company has used them.

## PERSONAL NOTES.

MR. JAMES A. ROBERTS has been nominated for Comptroller of Buffalo, N. Y., on the anti-Sheehan ticket. Mr. Roberts is well known among the electrical fraternity, and is vice-president of the Buffalo & Niagara Falls Electric Light and Power Company and connected with several other electrical interests.

## MISCELLANEOUS NOTES.

ELECTRIC RAILWAY FOR EGYPT.—The Egyptian government has decided to authorize the construction of a system of tramways in Cairo, and it is thought that electricity will be adopted as the power.

THE NEW YORK ELECTRICAL SOCIETY will hold its 153d meeting at Columbia College, on Tuesday, Oct. 31, at 8 p. m. Mr. D. McFarlan Moore will lecture on Electricity in Advertising, and will describe the latest developments in this branch of electrical application.

GENERAL ELECTRIC.—The force of employees in the works in Lynn is being added daily, and it is stated that the indications are that there will be an early resumption of the scale prevailing before the business depression. The payroll last week is reported to have been about $25,000.

MR. GEO. E. BOWEN, of Dundee, Ill., has again shown that he possesses literary ability as well as engineering skill, as is evidenced by the cards of Mr. E. C. Hawley, president of the Dundee Electric Light Company. Upon the reverse of these cards is found a number of bright questions and answers which are take-offs in one way of another on electrical subjects or current electrical questions. Each card has a different set, showing the variety and ingenuity of the author.

W. F. C. HASSON, the electrical engineer of the Midwinter Fair, is preparing plans and specifications for exterior and interior illumination at the Midwinter Fair. It is expected that the electric lighting feature of the fair will be most effective of all. All electric lighting companies will have opportunities to bid on the prospects. About 2,500 h. p. will be necessary; 12,000 incandescent lights and 750 arc lamps will be needed.

THE YOUNG MEN'S INSTITUTE'S evening educational classes, No. 222 Bowery, have a larger enrollment than in any previous year in the history of the institution. Over 40 are taking the course in steam engineering, 35 in the class in electricity, 40 in bookkeeping; altogether 300 young men, who are working in the day time, here employ their evenings seeking mental improvement. Special attention is given to technical studies, and the membership is largely made up of young mechanics.

THE MUNICIPAL OWNERSHIP LEAGUE, of Buffalo, of which J. N. Adam is president and many other prominent business men are members, has announced that it will ask all candidates for legislative and municipal offices to state publicly their views on the municipal ownership of public lighting plants, both gas and electric. The league is reported to be the outcome partly of local indignation against the various gas company jobs which Mr. Sheehan and his subordinates are said to have promoted at Albany.

MR. T. DE Q. TULLY has proposed a new rapid transit system for Brooklyn, using electricity. The cars are half as wide as those now in use, and are divided into compartments, each of which will seat four passengers. A door in the side of the car gives admission to each compartment. He proposed to widen the present elevated superstructure so as to give room for four narrow-gauge tracks, two for express trains and the others for way trains. The power is communicated to the motors through a third rail.

## Trade and Industrial Notes.

THE LACLEDE CARBON AND ELECTRIC COMPANY has moved its plant to Kokomo, Ind.

THE BERLIN IRON BRIDGE COMPANY will supply the iron work of the new meter house of the East River Gas Company, which will be entirely of brick and iron.

THE STANDARD ELECTRIC COMPANY, of Los Angeles, Cal., of which Mr. A. S. Perry is proprietor, will hereafter carry on an extensive electrical construction business.

T. F. WELCH & CO., 65 Sudbury street, Boston, Mass., have issued an 1893-94 catalogue and price list of hardware and of tools, many of which are used in electrical work.

THE JONSON ENGINEERING AND FOUNDRY COMPANY, foot of East 118th street, is about to place on the market a new automatic electrical track switch of extreme simplicity.

THE CUTTER ELECTRICAL AND MANUFACTURING COMPANY, 27 South Eleventh street, Philadelphia, has issued a pamphlet describing their new C-S automatic magnetic cut-out and C-S quadruple break switch. A feature is a catechism bringing out the points of the devices.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received the contract for the new drawbridge at Salem, Mass. The bridge will have a 60-foot opening, with a roadway 28 feet wide in the clear and two sidewalks, each six feet wide. It will be a deck plate girder construction.

THE BRADBURY STORAGE BATTERY COMPANY states that it is now prepared to go into heavier work, and will follow the example set by European manufacturers in placing upon the market batteries of a larger type. The company will continue to furnish batteries for light work as heretofore, as it has met with a flattering success in this line.

H. PETERSON, OF THE PETERSON ELECTRICAL WORKS, 256 Grove street, Milwaukee, Wis., who is the inventor of the Peterson electric railway system for the propulsion of cars by means of an underground conduit, has decided to form a stock company, which will probably be capitalized at $1,000,000, and the manufacture of the system will be commenced in due time.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, Ill., reports that the opening of the fall season is causing a brisk demand, among other things, for its Acme expanding wire guard, which was placed on the market about a year ago, and which has met with great success. This wire guard is easily and firmly fastened to the socket without any auxiliary fastenings or clips and is light and symmetrical in appearance.

THE DETROIT, MICH., MOTOR COMPANY has taken advantage of the new city ordinance, and will go into the lighting business on a large scale. Mr. John T. Foxen has been engaged as manager of the lighting department, and has already obtained orders for more than 2,500 incandescent lights. Among large orders received is one from Rev. Fr. Van Antwerp, of 500 lights for the Church of the Holy Rosary, parish hall and parochial residence.

THE UNIVERSAL ELECTRIC LAUNCH COMPANY, 45 Broadway, New York, has issued a catalogue illustrating and describing the electric launches and launch motors made by it, the latter of the well known Riker type. Full specifications are given of the various sizes of launches, of which several are illustrated. The neat pamphlet partakes largely of the character of a monograph on the subject and will be found of interest to both the lay and professional public.

MR. NAT. W. PRATT, of the Babcock & Wilcox Company, recently received a box from Mr. De Pey, their Philadelphia representative, containing a big persimmon and the announcement that the order of the Philadelphia Traction Company had been secured. This pleasing news was set forth on a small card inclosed in the box, worded as follows: "This is to inform you that we have yanked the persimmon." Mr. Pratt was much amused at the contents of the box and very well satisfied with the kind of fruit their efforts had brought down.

QUEEN & CO., incorporated, Philadelphia, loaned a number of standard instruments to the World's Fair Committee of Judges, for use in making tests, and have received the following courteous acknowledgment from Secretary Anderson: "The Committee of Judges has instructed me to convey to you their sincere thanks and hearty appreciation of your kindness in furnishing them instruments for use in their tests." Two additional awards have been granted to Queen & Co., making seven in all, received so far, and they are hoping for several more.

MESSRS. THOMPSON & INNESS, 115 Broadway, New York, have succeeded the Manhattan Equipment Company, dealers in railway equipment and supplies, and will continue the business at the above named address. Messrs. Thompson & Inness have secured the agency for sale of glass manufactured by the American Wire Glass Manufacturing Company, whose product is remarkable for its strength and is invaluable for car sheds, skylights, etc., where light and strength are required. Mr. Thompson was formerly secretary and treasurer of the Brooklyn City Railroad Company, while Mr. Inness was manager of the Manhattan Equipment Company.

MR. F. A. SCHEFFLER, 74 Cortlandt street, New York City, general sales agent of the Stirling water tube boiler, reports the following recent sales: Adriance Platt & Co., Poughkeepsie, N. Y., 250 h. p.; Simpson & Watkins, Scranton, Pa., three boilers of 300 h. p., this being their second order; Lutz, Lilly & Co., Philadelphia, 250 h. p., this being also a second order, and an additional 500 h. p. for the Union Railway Company, of New York City, who recently put into service 50 h. p. of same boilers. The company has received numerous letters showing conclusively that the claims of the Stirling boilers for circulation, self-cleaning and economical fuel consumption are well founded.

**MR. JARVIS B. EDSON, of 87 Liberty street, New York, manufacturer of the well known pressure-recording gauges bearing his name, has just received an order for one of his latest and most improved styles of pressure-recorders from the Memphis (Tenn.) Light and Power Company. This company, like many more electric light and power companies, feel that a record of the steam pressure carried for the twenty-four hours is absolutely essential, for obvious reasons. The Edson Recorder gives a record of the pressure carried for the twenty-four hours, and each hour is printed on the chart, which is ruled to the special scale of the instrument. The portion of chart traced upon is removed daily and placed in a chart album, specially provided therefor. This enables a firm or company to keep a ledger account of their boiler, which is exceedingly useful for reference.**

THE WASHBURN & MOEN MANUFACTURING COMPANY have just completed an order for railway feeder wires, given by the Brooklyn City Railway Company. This order included 180 miles of 500,000 c. m. stranded "Weatherproof" feed wire, together with about 30 miles of another size. It represented a weight of about 2,000,000 pounds, amounted to about $300,000, and is believed to be the largest single order for insulated wire ever placed in this country. This company had previously furnished the Brooklyn City Railway with a quantity of this same style and size of wire, and the recent purchase was the direct result of the high quality of wire furnished by them and the very satisfactory manner in which the business was handled. The Washburn & Moen Manufacturing Company have erected and equipped a large factory devoted exclusively to the manufacture of insulated wires and are pushing this department of their business in a very energetic manner.

IMPORTANT TRANSFER OF MINING PROPERTY.—A large mining property transfer of the past year was consummated on Oct. 14, when Mr. W. R. Elmonhorst, of Montreal, sold all his interest in the lands, mining rights, equipment and mined material comprising "The Lake Girard Mica System" to Mr. Thomas J. Watters, of Ottawa. By this operation Mr. Watters becomes the absolute owner of perhaps the largest and most valuable area of mica deposits on this continent known to be held by any single individual. The development of the series of deposits in question has been steadily continued during the past three years, and the conditions of the various properties are such that with a renewal of the demand for mica the output of this mineral, which has been greatly restricted for the past few months, can be greatly increased. It is understood that arrangements are being perfected whereby under lease of all said properties, etc., the business of "The Lake Girard Mica System" will be operated vigorously for the future.

1,200-H. P. TURBINE FOR NIAGARA.—Another water wheel has just been shipped to Niagara Falls by James Leffel & Co., of Springfield, O. It is a duplicate and of nearly the same power as one which was shipped some six months ago to the Cliff Paper Company, and is intended for the same parties. The wheel is of the new type on horizontal shaft, and is known as the James Leffel double discharge turbine, the entire weight being 30 tons. The water will be conducted to the wheel from a canal near the top of the cliff by an eight-foot pipe, extending downward until it reaches the mill, located near the foot of the cliff. The water will enter the cylinder casing of the wheel from below, passing upward a few feet, filling the case, and thus obtaining the head pressure. The amount of head will be about 130 feet; the wheel being some 67 inches in diameter, a speed of 225 revolutions will be obtained, and almost or quite 1,200 h. p. developed. The runner is made of bronze, with a very strong, heavy iron centre, all nicely proportioned and designed, and the mechanical construction finely executed. The wheel will connect direct to the powerful wood-grinding machinery, obviating entirely the use of the gears or belts. The machines will be located on each side of the wheel, affording a very simple design and arrangement for the whole plant.

## Business Notices.

**BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.**

# OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

## UNITED STATES PATENTS ISSUED OCT. 10, 1893.

(IN CHARGE OF W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.)

506,208. ELECTRIC MOTOR; J. A. Davis and R. A. Fowden, Philadelphia, Pa. Application filed Dec. 23. A step by step electric motor, comprising a slotted bar responding to electrical impulses in line and provided with pawl and ratchet connections for imparting step by step motion to a revoluble member located in the slotted portion of the bar and with pallet-and-escapement connections for equalizing the step by step motion and a circuit breaker and closer mounted on the revoluble member and adapted to control the impulses in line.

506,209. ELECTRIC MOTOR; J. A. Davis and R. A. Fowden, Philadelphia, Pa. Application filed Dec. 23, 1892. A step by step electric motor, having a revoluble member provided with a ratchet and escape wheels, a bar provided with a slot for the accommodation of the revoluble member, and with pivotal pawls, whereof one is provided with a hook-shaped extremity and rotates the ratchet wheel by a pull and whereof the other rotates said ratchet wheel by a push or thrust, and detents, pallets or stop dogs carried by the bar and adapted to limit and adjust the movements of the escape wheel.

506,223. TELEPHONE TABLET AND ARM REST; J. S. Gold, Columbus, O. Application filed May 18, 1892. A tablet comprising a shelf for supporting the tablet or paper, a plate secured to the under side of its inner edge and provided with a projecting edge that rests against the under side of the battery box lid, a support having its inner end secured to the upper side of the shelf and resting upon and extending across the top of the battery box, and a block secured to the under side of the outer portion of the support which engages the projecting edge of the battery box.

506,237. ELECTRIC CAR LIGHTING SYSTEM; F. E. Kinsman, Plainfield, N. J. Application filed Sept. 18, 1890. The combination of a dynamo machine, a driving mechanism therefor, and means for automatically connecting and disconnecting the dynamo from the driving mechanism as the driving power varies.

506,269. PRINTING TELEGRAPH; R. J. Sheehy, New York. Application filed March 11, 1886. The combination of a type wheel, a printing platen, its lever, a mechanical connection between the platen and lever, and a tripping device for releasing the platen from the lever.

506,270. PRINTING TELEGRAPH; R. J. Sheehy, New York. Application filed Jan. 10, 1887. The combination with an electric motor having electromagnets and a revolving armature for advancing the type wheel shaft, or one or more permanent magnets applied to the cores of the electromagnets and magnetizing coils for the permanent magnets.

506,271. APPARATUS FOR SECURING SYNCHRONOUS MOVEMENT; R. J. Sheehy, New York. Application filed Dec. 31, 1887. An electric motor having a regulator, consisting of supplemental contact devices or circuit closers, operating to prolong the circuit connections existing at any given time and a speed controller momentarily cutting such devices out of circuit, in combination with electrically operated devices controlled by the motor.

506,272. PRINTING TELEGRAPH EXCHANGE SYSTEM; R. J. Sheehy, New York. Application filed Dec. 31, 1887. This consists of an electromagnet having a hollow core, a soft iron bar extending into the core and movable therein, a permanent magnet applied to the soft iron bar, and a supplemental armature applied to the hollow core.

506,273. PRINTING TELEGRAPH; R. J. Sheehy, New York. Application filed Oct. 31, 1890. The combination of the synchronizing line, a switch and primary of the inductorium included therein, the secondary circuit of the inductorium, the telegraphing line, and means for including the secondary circuit in the line. circuit in the line. (See illustration.)

506,274. TELEGRAPHY; R. J. Sheehy, New York. Application filed Dec. 23, 1890. The combination of a motor, a type wheel shaft and the clutch and gearing connection with the motor, the pole changer shaft, its loose gear driven by the motor, an electromagnetic clutch for clutching the pole changer shaft with the motor, a pole changer arresting magnet that also controls the circuit of the electromagnetic clutch, the keys and sunflower and circuit connections.

506,297. ELECTRIC SWITCH; W. W. Alexander, Kansas City, Mo. Application filed Feb. 16, 1891. In an electric switch the combination of a spring forming part of an electric circuit, a trip lever and connecting rod retaining the spring, and means for resetting the trip lever or switch.

506,305. MAGNETO-TELEGRAPH; J. A. Brown, Moline, Ill. Application filed July 26, 1893. In a dynamic telephone transmitter and receiver a horseshoe magnet, a solenoid forming a pole piece of the magnet and having its core constructed to vibrate in the field of the magnet and connected with the diaphragm and a pivoted spring support for the core.

506,311. MOLDING FOR ELECTRICAL [illegible] R. A. Fessenden, Pittsfield, Mass. Application filed Aug. 16, 1892. This consists of a metallic sheath or casing having one side removable and an interior filling or lining of fireproof insulating material provided with one or more grooves or holes for the reception of conductors.

506,275. AUTOGRAPHIC TELEGRAPH; R. J. Sheehy, New York. Application filed March 3, 1891. The combination in an autographic telegraph recording device, of an ink cup having a perforated bottom, a split needle or pin having two free nibs or inscribing points working through the perforations and a magnet for vibrating the pen.

506,282. ELECTROMAGNET; I. A. Timmis, London, England. Application filed Feb. 1, 1893. This consists of a core having a base plate of magnetizable metal, and a bobbin of non-magnetizable metal provided with one or more coils of wire and arranged round the core with its flanges wholly covering the ends of the wires, in combination with an armature consisting of a plate provided with a rim adapted to slide over the top of the coil, and a central portion adapted to slide within the bobbin.

506,294. TELEGRAPH TRANSMITTER; Charles Willoughby, San Francisco, Cal. Application filed Dec. 6, 1892. In a transmitter an electric carriage provided with a hinged catch, in combination with the character levers provided with raised surfaces or projections.

506,317. MEANS FOR SUPPORTING TROLLEY WIRES; Sam. Harris, Cleveland, O. Application filed June 5, 1893. This device comprises jaws arranged in pairs for grasping the trolley wires, these jaws being rigidly connected with each other, and upright extended posts between which are secured discs for attaching or suspending wires.

506,347. ELECTRIC CIGAR LIGHTER; C. B. Struble, Minneapolis, Minn. Application filed Jan. 10, 1893. The combination of an electric circuit and a source of electricity included therein, with a bulb to contain the inflammable fluid, a tube leading therefrom, a hinged cap inclosing same, and electric contacts connected with opposite sides of the electric circuit and adapted to engage when the cap is opened.

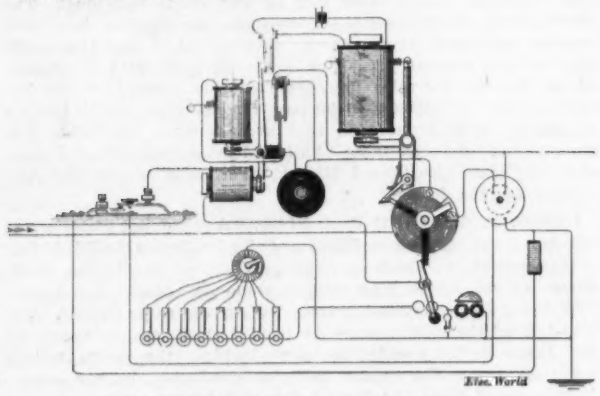
506,353. ELECTRIC BATTERY CELL; B. J. Wheelock, New York. Application filed Sept. 23, 1892. A porous cup for electric battery cells, constructed with its upper and lower edges hardened by the application of paraffin and ozokerite.

506,358. ELECTRIC LOCOMOTIVE; J. F. S. Branth, New York. Application filed March 23, 1892. An electric motor sustained beneath the body of a car and having the opposite ends of its armature shaft elastically connected to sleeves carrying pinions journaled on long pivoted journals with gear wheels on the sleeves and intermeshing wheels on axles of the car.

506,383. CUT-OUT; Elihu Thomson, Lynn, Mass. Application filed Oct. 27, 1888. This consists of a translating device on an alternating current circuit, of a transformer whose primary is of high self-inductive capacity, and is connected to the general circuit at opposite sides of the translating device through uninterrupted connections, a secondary for the transformer constructed to supply a current of larger volume than that of the general circuit for producing quick and large heating effects and a switch controlling the flow of the current to the translating device, and being controlled by heating effects due to the secondary.

506,415. TELEPHONE TRANSMITTER; J. V. Capek, New York. Application filed July 19, 1893. The combination with a telephone diaphragm, of a sound intensifier having differently tuned parts and a mouthpiece or sound collector. (See illustration.)

506,449. METHOD OF TREATING DISEASES ELECTRICALLY; Sam Silsbee, New Utrecht, N. Y. Application filed June 30, 1893. This consists of treating the tissues of the human body by applying medical substances in suspension directly to the surface of the body, an electric circuit and an ozonized compound being between the electrodes of the circuit and the therapeutic agent, for carrying into the body the material in the presence of the ozone.




No. 506,273.—PRINTING TELEGRAPH.

506,459. CARBON FOR ELECTRIC ARC LAMPS; R. E. Ball, New York. Application filed April 28, 1892. The combination of a pair of carbon pencils arranged end to end in axial alignment and both of the same gradually diminishing in diameter or thickness from or near the butt end to the arc forming end thereof.

506,463. ELECTRIC RAILWAY TROLLEY; G. H. Benjamin, New York. Application filed June 30, 1893. In electric railways the combination of a working conductor, an electromotive vehicle and a liquid anti-freezing contact device carried by the vehicle.

506,481. FAN MOTOR; P. Elieson, New York. Application filed July 16, 1892. An electrically operated fan, comprising a base or pedestal, a motor held to turn thereon, a fan carried by the motor and held to run on the base or pedestal, and an operative driving connection between the friction wheel and the armature of the motor.

506,482. REGULATOR FOR DYNAMOS; W. H. Elkins, Cambridge, Mass. Application filed Feb. 27, 1893. In a dynamo, a stationary forward brush and movable rear brush of like sign, a main circuit, a direct connection between the forward brush and the main circuit, and a resistance between the rear brush and the main circuit, all combined and arranged to reduce the electromotive force of the dynamo by moving the rear brush away from the forward brush, and to increase that electromotive force by moving the rear brush away from the forward brush.

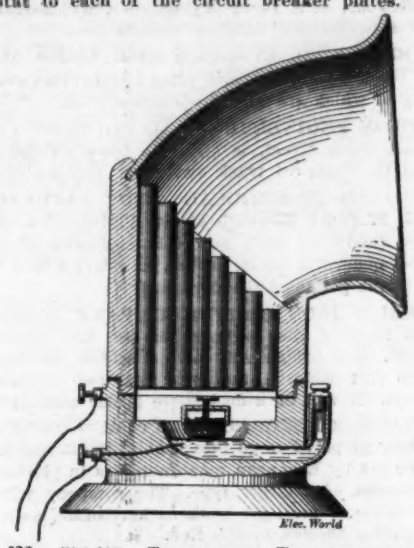
506,492. TROLLEY; G. F. Green, Kalamazoo, Mich. Application filed April 28, 1892. The combination with the pivoted casing containing the insulating conducting contact device formed of a series of metal strips or plates, as described, a supporting standard for said casing, said standard being provided with a curved deflecting portion.

506,503. ELECTRIC ARC LAMP; Carl Hoffman, Berlin, Germany. Application filed April 5, 1893. The combination with the arc forming and carbon feeding mechanism of an electric arc lamp, of a magnet having one leg wound with a coil in series with the arc, another leg with a coil in shunt around the arc, and an armature for said magnet pivoted at one end and inclosed by the legs of the magnet and having thereon a coil in series with the shunt coil.

506,516. ELECTRICAL HEAD CLAMP FOR RELIEVING PAIN; Lizzie Lane, Dunellen, N. J. Application filed May 27, 1893. In a clamp of the class described, a sectional adjustable spring band, and metallic contact plates having clamps removably attached to the free ends of said band.

506,563. ELECTRIC SWITCH; Frank Stevens, Philadelphia, Pa. Application filed April 21, 1893. This comprises a hollow frame supporting the electric terminals on one side thereof, a pivoted contact lever mounted within the hollow frame and engaging the terminals, a rocking lever independently mounted within the frame, a spring connecting the free end of the contact lever with one end of the rocking lever, and separately movable push-buttons extending through one side of the frame and having toes arranged to engage the rocking lever.

506,569. AUTOMATIC DRAFT REGULATOR; Harry L. Tyler, Corning, N. Y. Application filed March 25, 1893. In an automatic draught regulator, a metal casting having a parallel upright bearing arms, a single shaft journaled in said bearing arms, and uninsulated therefrom, a single large toothed gear wheel mounted on the shaft between said bearing arms, oppositely disposed crank arms attached to the opposite extremities of said shaft and connected with regulating cords, an attachment board secured to one of the bearing arms at its upper end, circuit breaker plates arranged out of contact with each other on both sides of one end of said shaft and attached to said board, a traveling contact brush axially adjustable on one of the shafts and adapted to travel in contact with said circuit breaker plates, an electric motor in circuit with a battery and said metallic bearing arms, the armature of the motor carrying a worm, mashing with the lower portion of said gear wheel, a thermostat in circuit with the battery, and separate circuit wires leading from the thermostat to each of the circuit breaker plates.




No. 506,415.—TELEPHONE TRANSMITTER.

506,577. ELECTRICAL TRANSFORMER OR INDUCTION DEVICE; James M. Adams and Martin Adams, Elkhart, Ind. Application filed June 22, 1893. The combination with an induction coil having primary and secondary wires, an inner core wrapped with iron wire, of an envelope or outer core wrapped with iron wire, and means for connecting the parts together.

506,582. AUTOMATIC FIRE ALARM SYSTEM; G. W. Brown, West Newbury, Mass. Application filed Sept. 1, 1892. The herein described annunciator, consisting of the magnet coils having their cores connected by the yoke and front strap, a target pivoted to the front strap, an armature pivoted between the coils of the said electromagnets, a stud or pin on the armature to act on the target.

506,617. TROLLEY SUPPORT FOR ELECTRIC RAILWAYS; J. M. Anderson, Boston, Mass. Application filed April 14, 1893. In a trolley pole supporting mechanism the combination with a base of a supporting frame pivoted thereto at or near one end and consisting of side and end pieces, a trolley pole holder secured to the side pieces to rock in a substantially vertical direction, springs connected to the trolley pole holder, a cross bar movable on the side pieces of the frame and to which the springs are connected, and means to move said cross bar.

506,627. VARIABLE RESISTANCE FOR MICROPHONES AND METHOD OF MANUFACTURING SAME; A. C. Cousens, Boston, Mass. Application filed Jan. 9, 1893. A variable resistance material consisting of a support or nucleus of suitable material having a chemically deposited surfacing of a titanium compound.

506,646. TELEPHONE ATTACHMENT; C. H. Dorenwend, Toronto, Can. Application filed June 3, 1892. An attachment to the receiver of a telephone instrument composed of a flexible tube, one end of which is held in position by a pivoted arm and adapted to inclose the exposed part of the diaphragm of the telephone receiver while the other end of the flexible tube is forked, an earpiece fitted to each of the tubes, means for raising the supporting hook to form a speaking circuit through the telephone instrument, a pin passing through the pivot block and the said arm.

506,650. CARBON ELECTRODE FOR ARC LAMPS; M. Lacombe, Paris, France. Application filed Aug. 27, 1892. A carbon or electrode composed of plates or discs of carbon arranged side by side and having between them a steadying substance or composition, the whole being united by pressure or otherwise.

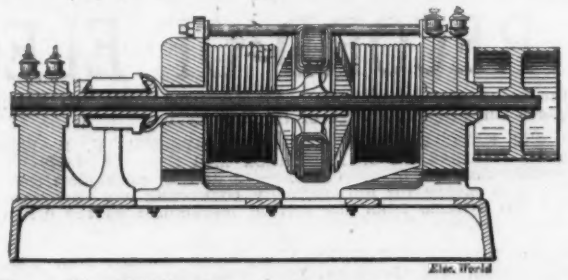
## UNITED STATES PATENTS ISSUED OCT. 17, 1893.

(IN CHARGE OF W. A. ROSENBAUM, 177 TIMES BLDG., N.Y.)

506,658. MULTIPLE COMMUTATOR APPARATUS FOR TELEPHONE SYSTEMS; L. A. Berthon, Paris, France. Application filed June 15, 1892. In contact plugs for the spring-jacks of telephone apparatus, two metallic conducting pieces in combination with an insulating material carrying the same and molded thereto, the metallic pieces being constructed with projections or shoulders against which the insulating material is molded, whereby their displacement is prevented, and they are insulated from one another.

506,683. JUNCTION BOX FOR ELECTRIC CABLES; S. B. Fowler, Chicago, Ill. Application filed April 12, 1893. The combination, with the cables, of a water-tight junction box, and water-tight terminals inside said box.

506,700. AUTOMATIC SPRINKLER AND FIRE INDICATOR; J. S. Kiehl, Chicago, Ill. Application filed Oct. 19, 1892. In an automatic sprinkler and fire indicator, a pump, a motor to actuate the pump, a pipe extending from the pump to a water supply, a pipe extending from the pump to the several




No. 506,740.—DYNAMO-ELECTRIC MACHINE

rooms of a building, distributing pipes extending from the last named pipe, a thermo-circuit closer located in such building, and wires extending from an electrical generator to the thermo-circuit closer and to the motor actuating the pump, whereby when the circuit formed by such wires and thermo-circuit is closed the motor and pump will be actuated and water will be forced through the pipe from the pump and through the distributing pipes.

506,716. CLUTCH FOR CARBON RODS; C. McNellis, Chicago, Ill. Application filed June 6, 1893. A clutch having a lever with an adjustable jaw, and a base with a fixed jaw opposed to the adjustable jaw, one or both of said jaws provided with a separate gripping part or parts which may be removed or replaced when worn out.

506,729. ELECTRIC PUSH BUTTON; B. F. Rex, St. Louis, Mo. Application filed Feb. 16, 1893. A hollow air-tight annunciator button having the air exhausted from its interior, formed in whole or in part of a transparent substance and containing a conductor suitable for use in an incandescent electric lamp, connected with conductors in whole or in part outside of said button and a spring compressible by pressure upon the button.

506,733. MANUFACTURE OF ELECTRIC LAMPS; H. and F. G. A. Schulze-Berge, Brooklyn, N. Y. Application filed March 25, 1892. In a system for exhausting electric lamp bulbs adjustable manometers interposed between the vacuum chamber and the pipes carrying the lamp bulbs or groups of lamp bulbs to be exhausted.

506,740. DYNAMO-ELECTRIC MACHINE; S. H. Short, Cleveland, O. Application filed April 13, 1891. The rotary armature of a dynamo-electric machine, composed of an annular core having notches in the sides of greater depth than width and insulated wire bobbins of less thickness than depth wound in said notches and projecting beyond the periphery of the core. (See illustration.)

506,774. DYNAMO-ELECTRIC MACHINE; F. A. Feldkamp, Newark, N. J. Application filed Nov. 15, 1892. A dynamo-electric machine provided with iron standards having supporting plates or pieces formed at and extending from one side of the standards, stationary magnets arranged one above the other and connecting with the supporting plates, the standards being outwardly curved, and an armature rotating between the standards and between the magnets.

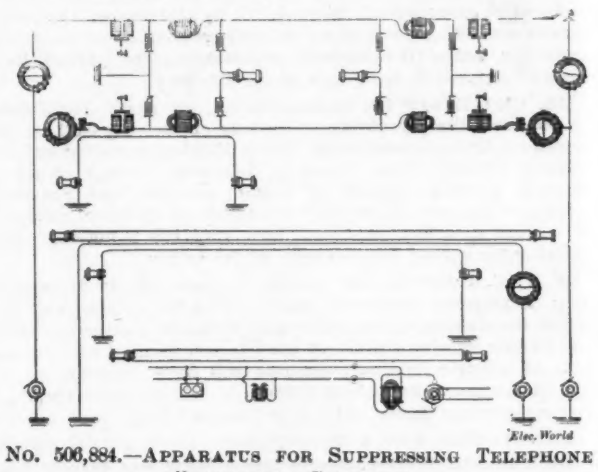
506,775. DYNAMO-ELECTRIC MACHINE; F. A. Feldkamp, Newark, N. J. Application filed Nov. 19, 1892. A dynamo-electric machine having a base provided with a pole piece, stationary magnets arranged on the pole piece, and a pole piece on the magnets, socketed or chambered portions in the pole pieces, and an armature rotating in the socketed or chambered portions, the armature comprising therein a ring having a web and flanges and spirally wound metallic strips on opposite sides of the web provided with insulation, and an armature wire wound around the ring.

506,786. ELECTRIC LOCOMOTIVE; H. W. Libbey, Boston, Mass. Application filed April 21, 1892. In an electric locomotive a bent axle, wheels journaled thereon, the axle being fulcrumed to a plate, another plate and suitable springs being interposed between the plates.

506,830. INSULATED ELECTRIC CONDUCTOR; L. F. Requa, New York, N. Y. Application filed Dec. 24, 1892. An insulating conductor or group of conductors wound spirally with a paper ribbon and inclosed in a soft rubber sheath or tube.

506,841. ELECTRIC ALARM SYSTEM; G. F. Bulen, Bayonne, N. J. Application filed July 5, 1893. In an electric alarm system, a local circuit, passing through the valves of a protected building, and means for automatically indicating to said building, a ground in the circuit.

506,881. REGULATOR FOR DYNAMO-ELECTRIC MACHINES; J. Keller, Canton, O. Application filed Oct. 10, 1891. In an automatic current regulator, stationary contacts and pivoted contact hand of a friction pulley carrying the contact hand, gravity friction dogs provided with rounded heads engaging into an annular recess in the pulley on opposite sides of its centre, the adjustable rests loosely supporting the head of each dog, and the two motor magnets having vertically movable cores connected to the outer ends of the dogs.




No. 506,884.—APPARATUS FOR SUPPRESSING TELEPHONE DISTURBING CURRENTS.

506,883. VISIBLE SIGNAL; F. S. Perrin, New York, N. Y. Application filed May 15, 1893. An electromagnet having a tubular iron core, an iron rod loosely fitting said tubular core, and adapted, when the magnet is excited, to be repulsively actuated thereby so as to move lengthwise of the core, and a visual disc or device carried or actuated by the rod.

506,884. APPARATUS FOR SUPPRESSING TELEPHONE DISTURBING CURRENTS; F. A. Pickernell, Newark, N. J. Application filed June 6, 1893. The combination of a dynamo; and a working circuit supplied thereby, and including translating devices; of a differentially wound, series connected electromagnetic resistance included in the circuit. (See illustration.)

506,890. ELECTRIC ARC LAMP; A. Utzinger, Nuremberg, Ger. Application filed Dec. 15, 1892. An alternating current arc lamp having continuous acting regulating mechanism consisting of a rotating body or mass of metal mechanically connected to the electrodes and lying in the magnetic field of one or more electromagnets adapted to set up a shifting magnetic field.

506,920. ELECTRICAL SYSTEM OF DISTRIBUTION; C. O. Mailloux, New York, N. Y., and W. S. Barstow, Brooklyn, N. Y. Application filed April 12, 1893. The combination of a series of bus bars of graded potentials, a series of feeders or sets of feeders, switches for shifting the feeders at pleasure from one bus bar to another, a source of variable electromotive force, and means for varying the same while connected to a feeder transfer of the feeder from one bus bar to another.

506,921. SYSTEM OF ELECTRICAL DISTRIBUTION; C. O. Mailloux, New York, N. Y., and W. S. Barstow, Brooklyn, N. Y. Application filed June 23, 1893. An artificial resistance connected across bus bars, means for connecting any feeder terminal to either end of the resistance, and means for breaking the connection of the same end of the resistance with the bus bar to which the feeder is connected.

506,936. ELECTRIC SYNCHRONIZER FOR CLOCKS; H. S. Prentiss, Elizabeth, N. J. Application filed Nov. 3, 1892. A time-piece provided with a detent composed of a member actuated by the train of the movement and a second member actuated by an electromagnet, the two co-operating to arrest the motion of the train, and a switch actuated by the train to close the circuit through the electromagnet at the hours indicated by the time-piece and to maintain a closed circuit for a predetermined period thereafter.

506,973. PRINTING TELEGRAPH; L. P. Buck and F. D. Sweeten, Wilmington, Del. Application filed July 26, 1892. In a printing telegraph, an electric motor connected with the carriage of a typewriter so as to draw it back when operated, a battery, a switch adapted to connect and disconnect the battery and motor, a key connected with the switch so as to actuate it to make connection and means to actuate the carriage arranged to move the switch and cut out the motor when the carriage has moved back to the desired extent.

506,993. ELECTRIC RAILWAY CONDUIT; H. H. Franklin, Brooklyn, N. Y. Application filed July 13, 1893. As an improvement in electric conduit conductors, two fixed pulleys, a movable pulley mounted on a pivoted arm, and a spring to draw the latter from the former.

507,064. TROLLEY WIRE HANGER; B. B. Betts, St. Louis, Mo. Application filed Dec. 28, 1892. A trolley hanger having a fixed jaw, an adjustable removable jaw, a wedge adapted to hold the removable jaw in a clamping relation over an electrical conductor, and a wire fitted in the wedge and adapted to be bent upwardly against the fixed jaw, when the wedge is in position.

*Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1836—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.*